

## Review of *Chirothrips* and related genera (Thysanoptera: Thripidae) of the Americas, with descriptions of one new genus and four new species

SUEO NAKAHARA<sup>1</sup> & ROBERT G. FOOTTIT<sup>2,3</sup>

<sup>1</sup>504 Prince George Street, Laurel, Maryland, 20702-4247, USA

<sup>2</sup>National Science Program–Environmental Health, Canadian National Collection of Insects

Agriculture and Agri-Food Canada, K.W. Neatby Building, Room 3048, 960 Carling Avenue, Ottawa, Ontario, K1A 0C6, Canada

<sup>3</sup>Corresponding author. E-mail: Robert.Foottit@agr.gc.ca

### Abstract

The species of *Chirothrips* and related genera occurring in the Americas are reviewed. Seventeen species from the area are retained in *Chirothrips*, 15 species are treated in *Arorathrips*, two species in *Konothrips*, one species in *Oelschlaegera* and one species in the new genus *Unilobothrips*. The generic concepts of the four previously described genera are revised. Four new species, *Arorathrips childersi*, *Chirothrips hemingi*, *Konothrips colei*, and *Unilobothrips cornuatus* are described. *Chirothrips moultoni* Post is synonymized with *C. aculeatus* Bagnall, and *C. spinosus* Moulton with *Arorathrips texanus* (Andre). The following new combinations are proposed: *Arorathrips crassus* (Hinds), *A. crenulatus* (Hood), *A. dorsalis* (Hood), *A. lenape* (Hood), *A. oneillae* (Watts), *A. sericatus* (Hood), *A. texanus* (Andre), *A. vestis* (Hood) and *Oelschlaegera priesneri* (Hood) (all from *Chirothrips*). *Chirothrips mongolicus* zur Strassen is returned to *Chirothrips* from *Arorathrips*. Identification keys to genera and species, and known distributions of the species, are provided.

**Key words:** *Arorathrips*, *Konothrips*, *Oelschlaegera*, *Unilobothrips*, new synonyms, new combinations, identification keys, species distribution

### Introduction

All *Chirothrips*-related species breed in grasses and sedges. The eggs are deposited inside the florets or embedded in the ovaries (Doull 1956, Riherd 1954). In New Zealand, females of *C. manicatus* normally lay 1 egg per floret (Lewis 1973). Unlike most terebrantians, the larvae have atrophied legs and cannot walk. This stage and the pupal stages are found in the florets. The larvae of *C. falsus* Hood feed on the ovules and destroy the developing caryopses of certain grass species. In florets of other grass species, it feeds on the stigma and anthers (Watts 1965). *Chirothrips* adults feed on seedheads and foliage. Males are wingless and are restricted to plants upon which they developed. Mating occurs on the infested grasses and the macropterous females either remain or migrate to other plants. The adults overwinter in dead florets, stubble and debris (Lewis 1973, Watts 1965). In arid southwestern United States, some species hibernate under the bark of trees and in Spanish moss (Bailey 1957). *Arorathrips mexicanus* (Crawford), *Chirothrips aculeatus* Bagnall, *C. falsus* Priesner, *C. hamatus* Trybom and *C. manicatus* (Haliday) reduce commercial seed production and impede natural reseeding (Bailey 1948, Riherd 1954, Watts 1965).

The *Chirothrips*-like species were all assigned to the cosmopolitan genus *Chirothrips*, until Hood (1954) erected the genus *Agrostothrips* for *guillarmodi*, which he described from South Africa and Uganda. Knechtel (1960) described the monotypic *Ereikethrips* for *calcaratus* Knechtel from Romania. Bhatti (1990) assigned four additional *Chirothrips* species to *Agrostothrips*, one species each to new genera *Afrothripella*, *Longothrips*, *Konothrips* and *Oelschlaegera*, and four species to new genus *Arorathrips*. *Afrothripella* and *Longothrips* are each known only by the female holotype from the Ethiopian Region. Mound and Marullo (1996) treated six *Chirothrips* species known from the Neotropics in *Arorathrips*, and retained seven species in *Chirothrips*. In the latest work on this group for the European species, zur Strassen (2003) treated 15 species in *Chirothrips* and one each in *Agrostothrips* and *Ereikethrips*. Minaei and Mound (2010) placed *Agrostothrips* as a synonym of *Chirothrips*.

About 65 species of *Chirothrips* and related genera are currently listed in the world (Mound 2012). A total of 36 species (including the species described here as new) are known in the New World. Thirty of these species, including three invasive European species, are known from the Nearctic Region, and twelve species are known from the Neotropics of which five species are endemic. *Arorathrips*, *Konothrips* and *Unilobothrips* species are endemic in the New World. No *Chirothrips* species are endemic in South America. This study is primarily of the Nearctic species; the South American species are listed and discussed

**Anatomical structures.** New terms are used for several anatomical structures. Other diagnostic characters recently discovered or infrequently used are included in the descriptions and identification keys. Roman numerals are used for the antennal and abdominal segments.

**Antenna:** *Antennal segment II:* Normally produced laterally or angulate, occasionally asymmetrical or symmetrical. In *Arorathrips* the laterally produced segment II has a sense cone or seta on the apex of the process or subapically below on the margin (Fig. 1) The anterior margin of the process is usually convex and the segment looks like an inverted shoe. The anterior margin of segment II of some species is membranous laterad of the base of segment III. The apex of the lateral process in *Konothrips* is membranous and gland-like and the subapical sense cone is actually on the apex of the sclerotized portion of the process (Fig. 43). In Nearctic *Chirothrips* and *Unilobothrips*, segment II is symmetrical or laterally asymmetrical, angulate or produced (Figs 31 to 38, 52). The anterior margin in most species is rather straight. A thin seta is present at the apex of the process or angulation, or 1 or 2 thin setae are positioned subapically below the process on the lateral margin. In some *Chirothrips* species and in *Unilobothrips cornuatus* the females and males have differently shaped segment II.

*Antennal segment I:* *Arorathrips* and *Konothrips* have an enlarged segment I which is usually more than twice as wide as the base of segment II. Those of *Chirothrips* are not enlarged. Several species (e.g. *C. falsus* and *C. simplex* Hood) have a short transverse ridge positioned between the dorsal setae or further distally (Fig. 38). The ridge may resemble a dermal fold or a crease.

**Basantra:** The prothoracic ventral area between the fore legs (Fig. 6) is normally membranous or occasionally weakly sclerotized in some species. The extent of sclerotization varies.

**Facetal Pigmentation of Compound Eye:** The compound eye of all females in the group has five pigmented facets (Fig. 20). The number of pigmented facets varies in males because the compound eye of some species is reduced, with fewer facets (Nakahara 1988).

**Fore wings:** Females of all species of *Arorathrips*, *Konothrips*, *Oelschlaegeria* and *Unilobothrips*, and most species of *Chirothrips*, are macropterous. Females of *C. propinquus* zur Strassen from Arizona and *C. azoricus* zur Strassen from the Azores, and occasionally of *C. manicatus*, are brachypterous. In the New World, the known males of all genera are apterous or brachypterous. The male of *O. priesneri* (Hood) from Brazil was not available for study and no males are known for the two other congeners in the Ethiopian Region. According to zur Strassen (2003), the *Chirothrips* females in Europe are macropterous but in males the wings are not developed. In contrast, the males of the four species treated in *Agrostothrips* are macropterous (Bhatti 1990). Several species in *Arorathrips* have few costal setae on the fore wing, and may lack or have few setae basal of the anterior fringe cilia.

**Sculpture:** Dermal sculptural patterns are mainly specific characters on mesonotum, metanotum and abdominal segments. *Sculpture lines* (= *striae*): Oriented transversely as parallel lines, short lines, scalloped lines, anastomosing, reticulated, or rarely oriented longitudinally or diagonally. *Scalloped sculpture*: Lines forming a continuous series of scallops and are not elevated. *Tuberculate scallops*: Low tubercles that are elevated on posterior part and are joined to others or separated, and aligned in rows (Fig. 9) or scattered.

**Mesofurca.** Bhatti (1990) observed that the invagination of each arm of the mesofurca are separated in certain species, and used this character to distinguish *Arorathrips* from *Chirothrips*. In this study, the terms, “separated” (Figs 6, 47) and “approximated” (Figs 22, 66) mesofurcal invaginations will be used. The mesofurcal invaginations are separated in both sexes of the native New World species of *Arorathrips* and *Konothrips* and in *Chirothrips egregius* zur Strassen from South Africa, in brachypterous males of *C. aculeatus* Bagnall (zur Strassen 2003), and slightly separated in occasional male specimens of a few other *Chirothrips* species. Of the 36 species examined from the New World, females of 17 species have separated invaginations and 19 have approximated invaginations

**Posteromarginal flange (=craspedum) and plates:** These structures are posterior extensions of the abdominal tergites and sternites. The tergal flanges are normally membranous and can be difficult to observe when the abdomen is compacted. All species have a flange on the tergites normally in form of a continuous band with the posterior margin rather straight or variously lobed or toothed (Figs 7, 8, 10, 15). The flange of most species of

*Arorathrips* overlaps the posterior part of the tergite. In some species a series of separated lobe-like plates are present (Fig. 59). The sternites may have various numbers of low lobe-like to rather long conical or tooth-like separated plates on the posterior margin or the plates are absent.

**Prospinasternum:** Most terebrantians have a transverse band known as the prospinasternum on the prosternum between the ferna and mesosternum (Figs 6, 17). Females of most *Arorathrips* have a prospinasternum that is reduced, vestigial or completely absent (Nakahara 1991). Two species with slightly separated mesofurcal invaginations, *A. crenulatus* (Hood) and *A. lepanae* (Hood), have the prospinasternum more developed than in those species with widely separated mesofurcal invaginations.

## Methods

Measurements are given in micrometers and body length in millimeters. The measurements of the holotype are given first and followed by the measurements of the paratypes in parentheses. The produced part of the head is measured along the lateral margin from the eyes to the distal angulation.

Descriptions are given only for the genera and for the new species. Each species is treated in the identification keys. Information on synonymy and distribution is provided for all species and additional comments are given for some species when relevant. Synonymy of names proposed for New World populations are given, but full synonymy lists for the introduced species are omitted. Distribution summaries use standard postal abbreviations for U.S. states and Canadian provinces.

The acronyms of the depositories of type material of new species are as follows: CAS = California Academy of Sciences, San Francisco; CNC = Canadian National Collection of Insects, Ottawa; TESB = University of Texas Extension Service, Bryan; UASM = Strickland Museum, Department of Entomology, University of Alberta; UCD = University of California, Davis; USNM = U.S. National Museum of Natural History, Washington D.C. (Thysanoptera Collection at Beltsville, Maryland).

## Diagnosis of *Chirothrips*-related genera

Species of *Chirothrips* and the related genera generally have bodies that are somewhat flattened dorsal-ventrally.

**Female:** Head small and produced anterior of the compound eyes, with few to many bristle-like, stout or conical setae; compound eyes with 5 pigmented ommatidia (Fig. 20); antenna 8-segmented, without microtrichia, segment I enlarged or not, segment II symmetrical to laterally angulated or produced with an apical or subapical sense cone or seta. Pronotum subtrapezoidal, with short, fine or stout setae; prospinasternum well developed, reduced or absent. Mesonotum, metanotum and abdomen with few bristle-like or conical setae, or with numerous, short stout setae. Mesosternal furcal invaginations separated (Figs 6, 47) or approximated (Figs 22, 58). Macropterous except for one brachypterous species (which also lacks ocelli). Abdominal posterior segments well developed, with long ovipositor, or rather short, with reduced ovipositor; tergites with posteromarginal flange entire or with lobed or toothed posterior margins.

**Male:** Apterous or brachypterous, rarely macropterous; head without ocelli; compound eyes with fewer ommatidial facets and often with fewer pigmented facets than females; abdominal sternites with glandular areas.

**Larva.** Antennae and legs reduced.

## Key to *Chirothrips*-related genera in the Americas

- 1 Antenna (Figs 18, 32 to 38, 52) with segment I not enlarged, less than 2.5 times as wide as base of segment II; segment II symmetrical, asymmetrical, laterally angulate or produced with small seta apically or subapically; mesosternal furcal invaginations approximated (Figs 22, 58) except in a few males . . . . . 2
- Antenna (Fig 43) with segment I enlarged, more than 2.5 times wider than base of segment II; antennal segment II strongly produced laterally, with sense cone or seta apically or subapically; mesosternal furcal invaginations separated (Figs 6, 47) . . . 4
- 2(1) Female with interantennal process of head truncate apically, distinctly longer than antennal segment I (Fig. 53); venter of head with cluster of setae between compound eyes (Fig. 54); male with short lateral lobe on each side near apex of interantennal process (Fig. 63) . . . . . *Unilobothrips*, new genus

- Female with interantennal process of head conical (Figs 40, 41, 44), not (or only slightly) longer than antennal segment I; venter of head with normal complement of setae; male without lateral lobe on conical interantennal process. . . . . 3
- 3(2) Head with 14 plus pairs of short conical setae; mesonotum, metanotum and anterior abdominal tergites and sternites with several conical or stout setae; abdominal sternites with broad, posteromarginal flange; head strongly produced anterior to eyes, lateral margin of vertex at least 50  $\mu\text{m}$  long . . . . . *Oelschlaegera*
- Head with 2–6 pairs of short bristle-like or stout setae; mesonotum, metanotum and anterior abdominal tergites and sternites with bristle-like or short, straight setae; posteromarginal flange absent from abdominal sternites or represented by lobes, teeth or elongated plates; head variously produced or not produced. . . . . *Chirothrips*
- 4(1) Mesonotum with 4–6 conical or stout spine-like setae in median area (Fig. 48); anterior abdominal tergites with D1 and D2 setae conical or stout, spine-like (Fig. 50) . . . . . *Konothrips*
- Mesonotum with 0–2 bristle-like or short stout setae in median area (Fig. 4) or with many small stout setae; anterior abdominal tergites with D1 and D2 setae bristle-like (Fig. 7) or with many small stout setae. . . . . *Arorathrips*

## *Arorathrips* Bhatti

*Arorathrips* Bhatti 1990: 194. Type Species: *Chirothrips mexicanus* Crawford by original designation.

**Female.** Macropterous. Antennal segment I enlarged, wider than long, at least 2.5 times as wide as base of II; segment II strongly produced laterally and diagonally oriented, normally with an apical sense cone (Fig. 1) or seta, rarely subapical. Head produced anterior of compound eyes, interantennal process conical and not projecting beyond antennal segment I; lateral margin of vertex variously produced between eye and antennal socket; vertex with short, stout setae. Pronotum with many short, stout, spine-like or fine setae; 0, 1 or 2 pairs of developed posteroangular setae. Mesonotum with a pair of median setae far anterior of posterior margin, a pair of setae on or slightly anterior of posterior margin. Mesosternal furcal invaginations separated (although barely so in *A. nigriceps*). Metanotum with median pair of short setae far posterior of anterior margin, shorter to subequal with lateral setae on anterior margin; a pair of campaniform sensilla present. Fore wings with costal setae. Abdominal tergites with few to numerous discal setae; posteromarginal flange overlapping posterior part of tergite; abdominal segments IX and X short; sternites with or without posteromarginal lobes; ovipositor short, usually less than 160  $\mu\text{m}$  long.

**Male.** Apterous or brachypterous. Smaller and usually paler than females. Abdominal sternites III–VII each with small oval to rather large transversely oval or oblong glandular area.

**Comments.** Sixteen species are assigned here to this genus. Of the four species placed in *Arorathrips* by Bhatti (1990), *A. crassiscelis* (zur Strassen), *A. mexicanus* (Crawford) and *A. sensitivus* (Andre) are congeneric, but *A. mongolicus* (zur Strassen) from Mongolia belongs in *Chirothrips* (**Revised Combination**) because the mesosternal furcal invaginations are approximated, antennal segment I is not enlarged and segment II is only angulated laterally. The fore tibia of each of these four species has a well developed outer apical process (Fig. 11), which was one of the three anatomical characters Bhatti used to define the genus. However, the fore tibial outer apical process is slightly to moderately developed in several species in other genera, and the process is here considered a specific character. All species retained in *Arorathrips* as here defined are thus endemic to the New World.

*Arorathrips* includes three species groups and four miscellaneous species. Members of the *mexicanus* group, consisting of *A. crassiscelis*, *A. crenulatus* (Hood), *A. mexicanus* and *A. sensitivus*, have dermal tuberculate scallops in a row (Fig. 9) or band (Fig. 10) on the anterior part of abdominal tergites, on sternites and on mesonotum of some species; metanotal campaniform sensilla are positioned at midlength or slightly posterior on the notum; and there are five pairs of dorsal setae on abdominal tergites III–VII. Fore tibial outer apical process is as long as, or longer than, first tarsal segment except shorter in *A. crenulatus*.

Members of the *crassus* group, consisting of *A. crassus* (Hood), *A. fulvus* (Moulton), *A. oneillae* (Watts) and *A. spiniceps*, (Hood) have minute teeth on the mesonotal sculpture lines (Fig. 14); anterior 1/3 to almost 1/2 of abdominal tergites are differentiated from rest of the tergite by the derm normally being paler and with a series of close-set transverse striae (Fig. 15) which may be finely crenulated or granulose; fore tibial outer apical process is not developed; metanotal campaniform sensilla are near the posterior margin; abdominal tergites III–VII with 5–6 pairs of dorsal setae, except in *A. fulvus* which has 9–15 pairs of longer setae on the submarginal–lateral area; and sternites without tuberculated scallops or posteromarginal lobes.

Species in the *vestis* group, consisting of *A. dorsalis* (Hood), *A. sericatus* (Hood), *A. texanus* (Andre), and *A.*



*vestis* (Hood), have numerous setae on the dorsum and venter of the head and body, and the pronotum is weakly or not sculptured. Otherwise, these species are similar anatomically to species in the *crassus* group. *A. childersi*, new species, *A. lenape* (Hood), *A. nigriceps* (Hood) and *A. xanthius* (Hood) cannot be placed in any group.

*Arorathrips* shares with *Konothrips*, the other genus in the Western Hemisphere, enlarged antennal segment I, laterally produced segment II and separated mesosternal furcal invaginations. It differs from *Konothrips* by having bristle-like or short, stout mesonotal median setae far anterior of the posterior margin and pair of similar setae on or near the posterior margin, or numerous stout setae; well developed posteromarginal flange that overlaps posterior part of abdominal tergites; usually with several costal setae between base and first anterior fringe cilia on fore wing; lateral projection of antennal segment II lacks a distinct membranous gland on apex of process except in *A. xanthius*; and abdominal tergal and sternal striations are oriented transversely, reticulated or scalloped and only slightly diagonally oriented on the submargins. Conversely, *Konothrips* has 4–6 conical or spine-like discal setae in median area of the mesonotum; posteromarginal flange is short and arises from posterior margin of abdominal tergite; fore wing has 0–1 costal seta basal of first anterior fringe cilia; antennal segment II has a distinct membranous gland on apex of lateral process that protrudes over the sense cone; and abdominal tergal and sternal striae are strongly diagonally or longitudinally oriented on the submargins.

### *Arorathrips childersi* sp. n.

(Figs 1–7)

**Female.** Macropterous. Head brown, thorax lighter yellowish brown, abdomen lighter than thorax, yellow with grayish brown shading, except segment IX entirely yellow; legs brownish yellow; antennal segment I brown, II brownish yellow basally becoming gradually light yellow distally, III yellowish brown, IV darker yellowish brown than III, V–VIII brown; ocellar crescent red; fore wings yellow with light grayish brown tinge; body and fore wing setae light grayish yellow.

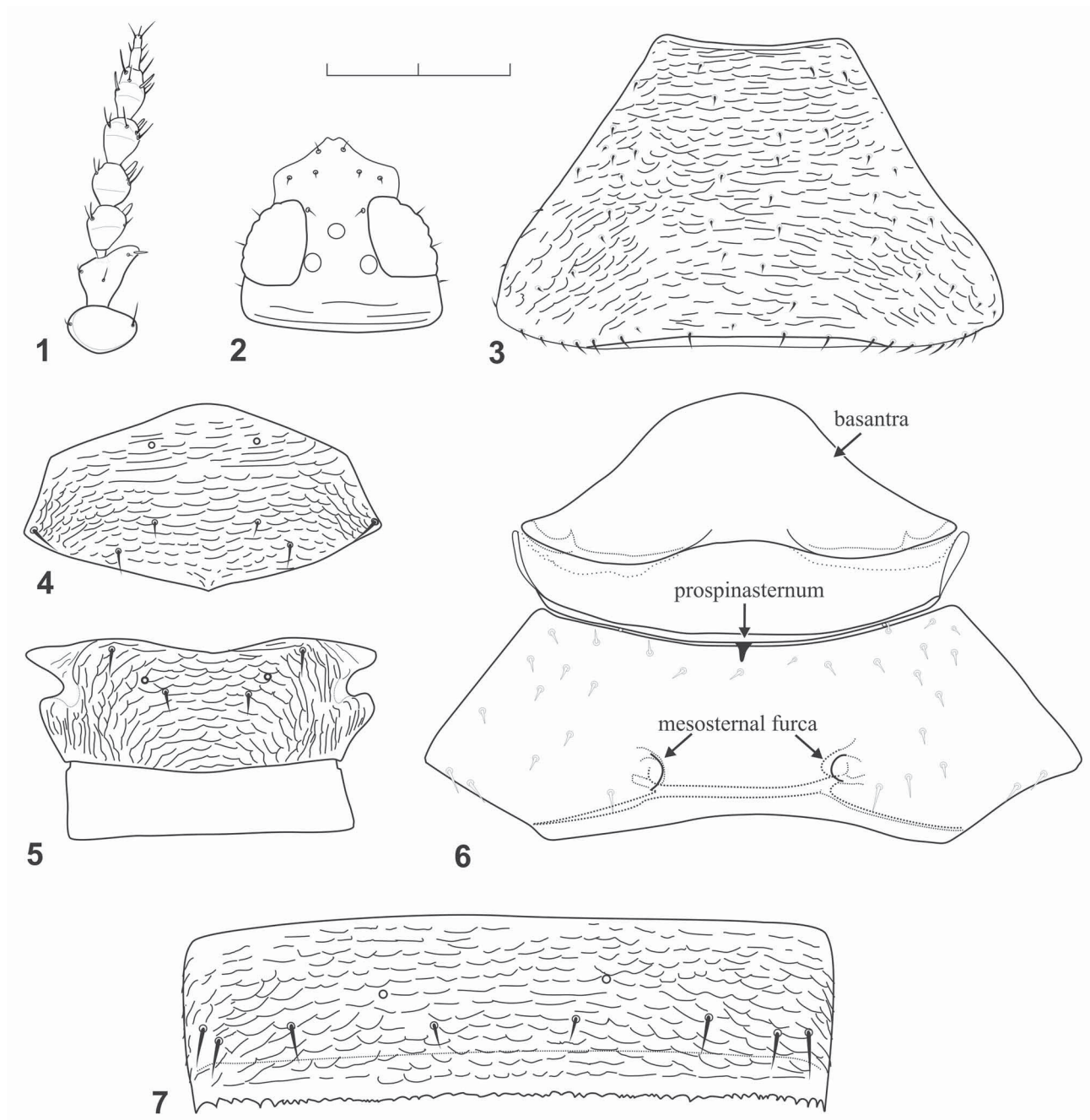
**Antenna** (Fig. 1): Segment I enlarged, diagonally aligned on head, about 2.7 times wider than base of II; segment II strongly produced laterally, lateral margin concave, narrowed at base, anterior margin of projection arched, diagonal dimension from apex of process to base of inner margin about 62  $\mu\text{m}$ , from apex to base of lateral margin about 54  $\mu\text{m}$ ; subapical sense cone, about 5  $\mu\text{m}$  long, projecting beyond apex; mediad of sense cone, a short dorsal seta, medially a short dorsal and a ventral setae, short dorsal and ventral setae on inner margin near apex of segment; segment IV about as long as wide; segment VIII shorter than VII; sense cones simple on III and IV, short, about 5  $\mu\text{m}$  long, sense cone on segment V poorly developed, inner sense cone on VI positioned about midlength of segment.

**Head** (Fig. 2): Prolonged anterior of eyes, longer than wide, lateral margin of vertex anterior of compound eyes about as long as occiput, slightly diverging cephalad to obtuse angle with diagonal anterior margin; compound eyes about 3 times longer than cheeks; 5 short setae on vertex; ocellar setae anterior of fore ocellus by about diameter of ocellus; venter with normal complement of setae; mouthcone shorter than head, broadly rounded apically.

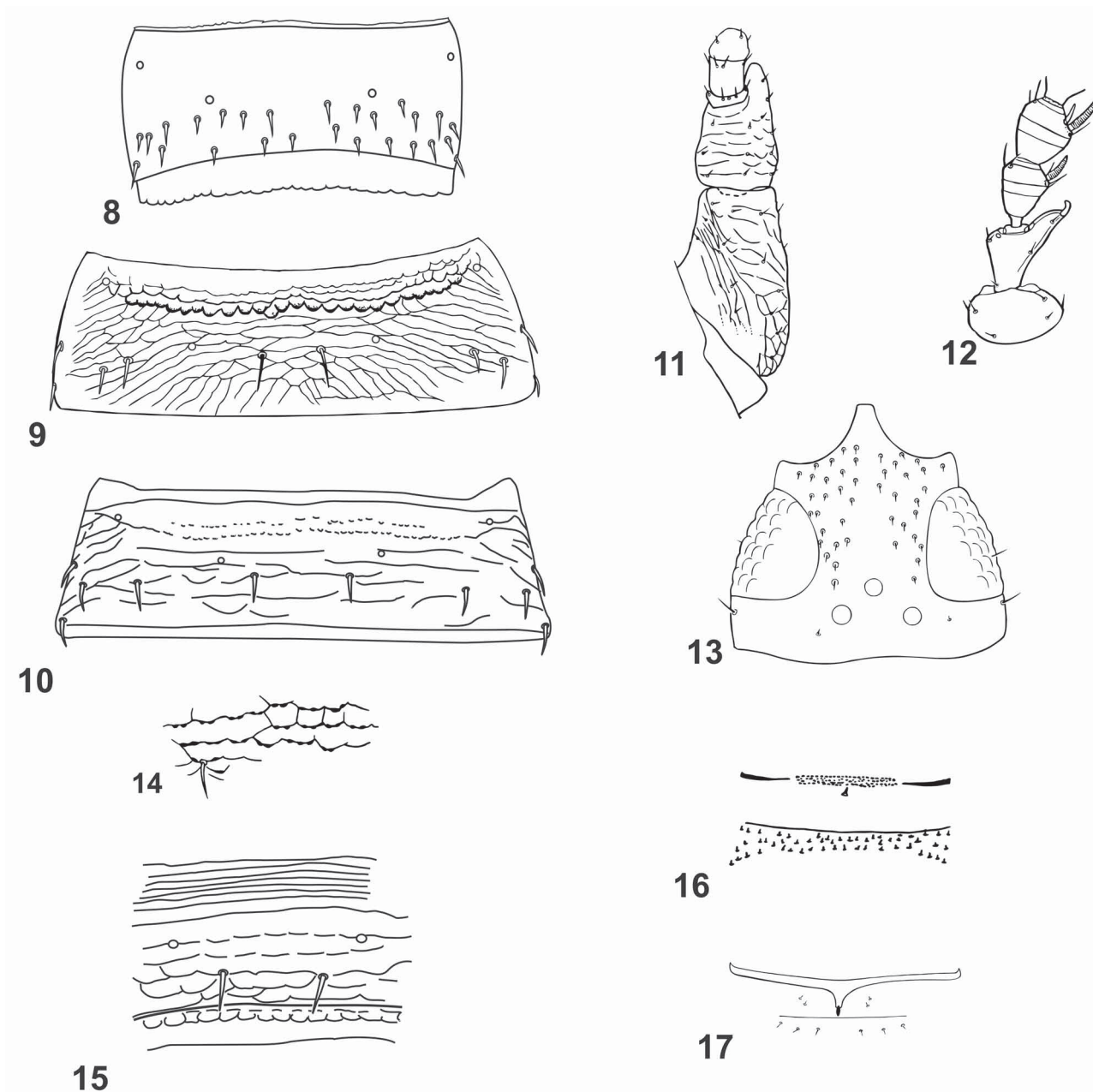
**Thorax:** Setae short, bristle-like. **Pronotum** (Fig. 3): subtrapezoidal, anterior margin considerably shorter than posterior margin, completely sculptured with transverse, scalloped lines; about 50 short, fine, discal setae, about 7  $\mu\text{m}$  long; posterior margin with 20 short, fine setae, longest about 12  $\mu\text{m}$  long, posteroangular setae not developed. **Prosternum** (Fig. 6) with basantra membranous, weakly textured, setae absent; ferna divided, indistinct, separation from basantra obscure; prospinasternum apparently a narrow transverse band with spina inserted into the mesosternum; membranous area between ferna and prospinasternum with rows of distinct fine granulose-spinulose sculpture. **Mesonotum** (Fig. 4): sculptured with transverse, scalloped lines, lines lacking minute teeth or not tuberculate; anteromedian campaniform sensilla farther apart than submedian setae; submedian setae far anterior of posterior margin, posterior setae slightly anterior of posterior margin. **Mesosternal furca** (Fig. 6) with invaginations separated by more than width of mesothoracic coxae. **Metanotum** (Fig. 5): sculptured almost completely with transverse scalloped lines except few striae longitudinally oriented near lateral margins; submedian setae slightly shorter than lateral setae, far apart by 45  $\mu\text{m}$ , positioned about anterior 1/3 of notum; campaniform sensilla cephalad of and farther apart than median setae. **Fore legs:** Enlarged, apex of femora not reflected, fore tibiae apically truncate.

*Fore wings*: Rather straight, tapering to blunt apex; with 14 costal setae, 1–2 basal of anterior fringe cilia, those at midlength about as long as width of wing; 19 anterior fringe cilia, wavy; 5 basal setae in proximal 1/2 and 2 setae in distal 1/2 on fore vein; 5 setae on hindvein; scale with 4 or 5 marginal and 1 discal setae.

*Abdomen*: Tergites (Fig 7) with sculpture lines scalloped; antecostal ridge not evident; median seta in caudal 1/3 of tergites, shorter than 4 setae laterad to it on tergites II–VII; median campaniform sensilla on II–VIII far anterior of median setae; posteromarginal flange 1/4 to 3/10 as long as tergite, overlapping posterior part of tergite, posterior margin with irregular teeth; tergite IX slightly shorter than X; segment X conical. Pleurotergites with posteromarginal teeth. Sternites with sculpture transverse, reticulated or striae slightly scalloped; posteromargins without lobes or flange; sternite I with 2 anteromedian setae; sternite II with 2 pairs of posteromarginal setae, III–VII with 3 pairs on posterior margin, median pair on VII closer to each other than to B2 setae; ovipositor 153  $\mu\text{m}$  long.



**FIGURES 1–7.** *Arorathrips childersi* sp. n., holotype female. (1) right antenna; (2) head, dorsal aspect; (3) pronotum; (4) mesonotum; (5) metanotum; (6) pro- and mesosterna; (7) abdominal tergite V. Scale bar 100 $\mu\text{m}$ .



**FIGURES 8–17.** *Arorathrips* species. (8) *A. sericatus*, abdominal tergite VI (after Hood 1949a). (9) *A. mexicanus*, tergite III. (10) *A. crenulatus*, abdominal tergite. (11) *A. crassiscellus*, right foreleg (after zur Strassen 1967a). (12) *A. crassus*, left antennal segments I to IV (after zur Strassen 1960). (13) *A. oneillae*, head, dorsal aspect. (14) *A. spiniceps*, metanotal sculpture. (15) *A. spiniceps*, abdominal tergal sculpture. (16) *A. spiniceps*, praespinalsternal area (after Nakahara 1991). (17) *A. crenulatus*, praespinalsternum (after Nakahara 1991).

**Measurements of holotype:** Body length 1.28 mm. Other measurements in  $\mu\text{m}$ . Antenna: Total length 215; length, width of segment I 24, 47, II 40, 44; III 37, 25; IV 27, 27; V 30, 24; VI 32, 20; VII 15, 71; VIII 10, 5. Head: length from interantennal process 42, margin anterior of eyes 17 long, compound eye 54 long, occiput 15 long. Pronotum 183 long, 128 wide at anterior margin, 321 wide at posterior margin. Fore wings 776 long, 50 wide at midlength. Abdominal tergite IX 62 long, X 72 long. Setae: tergite IX with B1 setae 101 long, B2 setae 91–99 long; tergite X with B1 setae 117 long.

**Male.** Unknown.

**Type material.** Holotype female, **U.S.A., Florida**, Hendry Co. 5–7 miles south of LaBelle, sticky card in navel orange orchard, 9-III-92, C. C. Childers (USNM).

**Distribution.** United States (Florida).

**Etymology.** Species named in honor of Carl C. Childers, the collector of the specimen.

**Comments.** Although only a single specimen is available, it is distinct enough that it is unlikely to fall within the variation exhibited by the known species. The postocular setae and part of interocular area of the head could not be observed because of the obstruction caused by the bleeding of the pigmentation from the compound eyes. Also the shape of propinasternum is difficult to observe.

This species is distinguished from other *Arorathrips* species as follows: head and body have few setae; vertex of head has five setae; pronotum lacks developed posteroangular setae, and discal setae are short, fine, bristle-like; fore tibia lacks outer distal process; mesonotum lacks tuberculate scallops, and sculpture lines lack minute teeth; metanotum is almost completely sculptured with transverse scalloped lines, median setae are far apart and the campaniform sensilla are anterior to the median setae; abdominal sternites lack posteromarginal lobes or flange.

### List of *Arorathrips* species

#### *Arorathrips crassiscelis* (zur Strassen)

*Chirothrips crassiscelis* zur Strassen 1967a: 24.

*Arorathrips crassiscelis* (zur Strassen); Bhatti 1990: 196.

**Distribution:** Brazil.

#### *Arorathrips crassus* (Hinds) comb.n.

*Chirothrips crassus* Hinds 1902: 136.

*Chirothrips obesus* Hinds 1902: 137; Hood 1939a: 464.

*Chirothrips obesus* var. *hubbeli* Watson 1926: 58; Hood 1939a: 464.

**Distribution:** Canada (QC) (Chiasson 1986), United States (AR, DE, FL, GA, IA, IL, IN, MA, NJ, NY, OH, SC, TN, VA) (Watts 1972, Beshear 1973).

#### *Arorathrips crenulatus* (Hood) comb.n.

*Chirothrips crenulatus* Hood 1927b: 130.

**Distribution:** Canada (AB, MB) (Chiasson 1986), United States (CO, KS, NB, ND, NM, OK, SD, WY) (Watts 1972, Huntsinger & Balsbaugh 1982).

#### *Arorathrips dorsalis* (Hood) comb.n.

*Chirothrips dorsalis* Hood 1939b: 560.

**Distribution:** United States (GA, TX).

**Comments:** This species is known only from the holotype.

#### *Arorathrips fulvus* (Moulton)

*Chirothrips fulvus* Moulton 1936: 182.

*Arorathrips fulvus* (Moulton); Mound and Marullo 1996: 94.

*Chirothrips dolosus* De Santis 1967: 5; Mound and Marullo 1996: 94.

**Distribution:** United States (TN, TX, HI), Argentina, Uruguay (zur Strassen 1960).

**Comments:** The abdominal tergites have 9–15 setae on each side and those located submarginally and laterally are longer than the median setae.

#### *Arorathrips lenape* (Hood) comb.n.

*Chirothrips lenape* Hood 1938: 355.

**Distribution:** United States (NJ, NY, WI).

**Comments:** Abdominal sternal sculpture lines are scalloped and the posterior scallops surpass the posterior margin and resemble lobes on the margin.

#### *Arorathrips mexicanus* (Crawford)

*Chirothrips mexicana* D.L. Crawford 1909: 114.

*Arorathrips mexicanus* (Crawford); Bhatti 1990: 196.



*Chirothrips floridensis* Watson 1920: 21; Andre 1939: 197.

*Chirothrips floridensis* var. *catchingsi* Watson 1924: 76; Hood 1927a: 112.

*Chirothrips saltensis* Tapia 1952: 109; zur Strassen 1960: 174.

**Distribution:** United States (AR, AZ, CA, FL, GA, HI, IL, MS, NC, NM, OK, TN, TX), Mexico, Central America, Caribbean Islands, Colombia, Brazil, Argentina, Mozambique, South Africa, Zimbabwe, Philippines, Thailand, Australia (Jacot-Guillarmod 1971).

***Arorathrips nigriceps* (Hood)**

*Chirothrips nigriceps* Hood 1952: 147.

*Arorathrips nigriceps* (Hood); Mound and Marullo 1996: 94.

**Distribution:** Brazil.

**Comments:** This species is known only from the holotype and one female paratype. Antennal segment II is strongly angulate with rather straight anterior margin and resembles those of some *Chirothrips* species. The invaginations of the mesosternal furca are barely separated by about 7 µm. Abdominal sternites have tuberculate scallops and low lobes on posterior margin. The head is brown, pronotum is yellow with a medial pale brown longitudinal area, pterothorax is shaded light brown, abdomen and legs are yellow, and fore wing is light brown with pale base.

***Arorathrips oneillae* (Watts) comb.n.**

*Chirothrips oneillae* Watts 1972: 589.

**Distribution:** United States (AR, SC).

**Comments:** This species has many short, stout setae on the head, pronotum and venter of meso- and metasternum, and a few setae on the basantra.

***Arorathrips sensitivus* (Andre)**

*Chirothrips sensitivus* Andre 1939: 198.

*Arorathrips sensitivus* (Andre); Bhatti 1990: 196.

*Chirothrips talpoides* Hood 1939a: 466; Jacot-Guillarmod 1971: 483.

**Distribution:** United States (FL).

**Comments:** Antennal segment I is more elongate than in other North American species and is only slightly wider than long. The head is greatly prolonged anterior of the eyes. The tibial process is about as long as tarsal segments I plus II, as wide as the tarsal segments. The lateral part of the tibia is strongly sculptured.

***Arorathrips sericatus* (Hood) comb.n.**

*Chirothrips sericatus* Hood 1949a: 18.

**Distribution:** Brazil, Uruguay.

**Comments:** This species has submarginal and lateral setae on abdominal tergites subequal to the median setae in contrast to other species in the *vestis* group with submarginal and lateral setae 2–3 times longer than median setae.

***Arorathrips spiniceps* (Hood)**

*Chirothrips spiniceps* Hood 1915: 12.

*Arorathrips spiniceps* (Hood); Mound and Marullo 1996: 95.

*Chirothrips sacchari* Moulton 1936: 181; Hood 1939a: 464.

**Distribution:** United States (AZ, CA, FL, HI, IL, KS, LA, MA, NC, OK, SC, TX, UT, VA), Bermuda, Cuba, Mexico, Argentina, Papua, Solomon Is. (zur Strassen 1960, 1967a, Watts 1972); a quarantine interception from Thailand in 2003.

***Arorathrips texanus* (Andre) comb.n.**

*Chirothrips texanus* Andre 1939: 200.

*Chirothrips auriventris* Hood 1939a: 469; Andre, in Bailey 1949: 78.

*Chirothrips spinosus* Moulton 1946: 56 **syn.n.**

*Chirothrips pubescens* Hood 1949a: 20; zur Strassen 1975: 78.

**Distribution:** United States (GA, IL, LA, MS, ND, NM, OK, TX); Mexico, Haiti, Brazil, Paraguay (Watts 1972).

**Comments:** *Chirothrips auriventris* known from NM, OK, TX and Mexico (records based on examined material) appears to be a form of *A. texanus* with a slightly smaller and slightly different shaped antennal segment II. When three dimensions (length from apex of lateral angulation to inner margin, apex of angulation to base of lateral margin, and apex of angulation to base of inner margin) of segment II were analysed for both taxa, those of *A. auriventris* were consistently similar and separable from those of *A. texanus*. However, the differences in the measurements were small and therefore, the senior author decided to continue treating *C. auriventris* as a junior synonym. According to the description of *spinosus* from Haiti, which is represented only by the holotype and a paratype, the fore wings are pale and the outer posteroangular setae are 43 µm long and the inner pair 26 µm long. The paratype examined in this study has similarly longer outer pair (48 µm long) than the inner pair (27 µm long). These specimens were collected in 1929 and described in 1946. Thus the color of the fore wing could have faded during the 17 year interval in alcohol. The fore wings of *C. texanus* and *C. pubescens* are light brown with the base pale and, according to Andre (1939), pronotal posteroangular setae of *C. texanus* are 40–49 µm long. Although *C. spinosus* has a longer body and antenna, it cannot be distinguished reliably from *C. texanus*.

***Arorathrips vestis* (Hood) comb.n.**

*Chirothrips vestis* Hood 1915: 15.

**Distribution:** United States (FL, GA, KY, NC, NJ, SC, TN, VA (Watts 1972: 593)).

***Arorathrips xanthius* (Hood)**

*Chirothrips xanthius* Hood 1934: 408.

*Arorathrips xanthius* (Hood); Mound and Marullo 1996: 95.

*Chirothrips oryzae* De Santis 1968: 254; Mound and Marullo 1996: 95.

**Distribution:** Panama, Argentina, Brazil.

**Comments:** A paratype of *C. oryzae* in the USNM apparently has a tooth on the first tarsal segment on each side. A tooth on the first tarsal segment is unusual and because the tarsi are collapsed, it is considered an artefact. Antennal segments I–III and most of IV and V are yellow. The head is brown and body is bright yellow with the apex of abdominal segment X brown. A specimen examined from Brazil was anatomically similar but the body and antenna were shaded more extensively brownish yellow.

**Key to species of *Arorathrips***

- |      |  |                          |
|------|--|--------------------------|
| 1    | Females; macropterous . . . . .  | 2                        |
|      | Males; apterous or brachypterous . . . . .   | 17                       |
| 2(1) | Dorsum and venter of entire body with numerous short, stout setae (Fig. 8); pronotum with weak or no sculpturing . . . . .   | 3                        |
|      | Mesonotum, metanotum and abdomen with few stout and/or bristle-like setae (Fig. 9) (may have numerous short setae on head and pronotum); pronotum distinctly sculptured . . . . .  | 6                        |
| 3(2) | Abdominal tergites II–V each with less than 20 setae medially in 1–3 rows between median campaniform sensilla, tergite I with fewer than 35 setae . . . . .  | 4                        |
|      | Abdominal tergites II–V each with more than 30 setae medially in a band between median campaniform sensilla, more than 40 setae on tergite I . . . . .   | 5                        |
| 4(3) | Head with more than 50–60 short, stout setae on vertex; pronotum with 2 pairs of posteroangular setae developed; antennal segment VI about 45 µm long; body brown; antennal segment I brown, II yellowish brown, III brown. . . . .  | <i>dorsalis</i> Hood     |
|      | Head with 30–40 short stout setae on vertex; pronotum with 1 pair of short posteroangular setae developed; antennal segment VI 27–32 µm long; head brown, thorax, abdomen and legs generally yellow; antennal segment I brownish yellow, II yellow, base to most of III yellow . . . . . | <i>vestis</i> Hood       |
| 5(3) | Lateral setae on abdominal tergites subequal or slightly longer than median setae; pronotal posteroangular setae 15–20 µm long; head brown in sharp contrast to yellow pronotum with pale brown longitudinal median band; antennal segment I and II yellow . . . . .                     | <i>sericatus</i> Hood    |
|      | Lateral setae on abdominal tergites 2.0 to 3.0 times longer than median setae; pronotal posteroangular setae 30–50 µm long; head brown, thorax lighter brown; antennal segment I brown, II yellowish brown, paler than I. . . . .  | <i>texanus</i> (Andre)   |
| 6(2) | Fore tibia with outer distal process produced usually beyond apex of first tarsal segment (Fig. 11); anterior abdominal tergites and sternites with tuberculate scallops (Fig. 9) . . . . .  | 7                        |
|      | Fore tibia without outer distal process; tuberculated scallops present or absent from abdominal tergites and sternites . . . . .   | 9                        |
| 7(6) | Head with 24–38 short stout setae on vertex; pronotum with 1 pair of developed posteroangular setae; fore tibial outer distal process extending to apex of second tarsal segment, as thick as tarsus . . . . .   | <i>sensitivus</i> (Hood) |

	Head with less than 20 short stout setae on vertex; pronotum with 2 pairs of posteroangular setae; fore tibial outer distal process not extending to apex of second tarsal segment, thinner than tarsus . . . . .	8
8(7)	Head with 10–18 short stout setae on vertex; fore wings with 0–2 weak costal setae basal of anterior fringe cilia; outer posteroangular setae shorter than inner pair . . . . . <i>crassiscelis</i> (zur Strassen)	
	Head usually with 6 short stout setae on vertex; fore wings with 5–6 developed costal setae basal of anterior fringe cilia; outer posteroangular setae as long or longer than inner pair . . . . . <i>mexicanus</i> (Crawford)	
9(6)	Mesosternal furcal invaginations separated by width of mesothoracic coxae (Fig. 6); intercoxal space between hind coxae wider than width of coxae; abdominal sternites lacking posteromarginal lobes . . . . .	10
	Mesosternal furcal invaginations separated by less than 1/2 width of mesothoracic coxae; intercoxal space between hind coxae less than width of coxae; abdominal sternites with posteromarginal lobes . . . . .	15
10(9)	Head with 30 or more short stout setae on vertex; basantra with setae . . . . .	11
	Head with less than 30 short stout setae on vertex; basantra without setae . . . . .	12
11(10)	Head with 55 or more short stout setae on vertex (Fig. 13); abdominal sternite II with 3–4 pairs, and sternites III–VI with 4 pairs, of posteromarginal setae . . . . . <i>oneillae</i> (Watts)	
	Head with 30–48 short stout setae on vertex; abdominal sternite II with 2 pairs, and sternites III–VI with 3 pairs, of posteromarginal setae <i>fulvus</i> (Moulton)	
12(10)	Antennal segment II with sense cone subapical on lateral process (Fig. 1); mesonotal sculpture without small teeth; abdominal sternites with posteromarginal setae on margin . . . . .	13
	Antennal segment II with sense cone apical on lateral process (Fig. 12); mesonotal sculpture with small teeth (Fig. 14); abdominal sternites with posteromarginal setae anterior to margin . . . . .	14
13(12)	Lateral margin of head anterior of compound eyes 24–27 $\mu\text{m}$ long, about 1/2 as long as compound eye; fore wing with about 5 costal setae, 0 seta basal of anterior cilia; head brown, body, legs and antennal segment I yellow. . . . . <i>xanthius</i> (Hood)	
	Lateral margin of head anterior of compound eyes about 17 $\mu\text{m}$ long, between 1/4 to 1/3 as long as compound eye (Fig. 2); fore wing with about 14 costal setae, 1–2 setae basal to anterior cilia; head, thorax and antennal segment I brown, abdomen yellowish, legs yellowish brown. . . . . <i>childersi</i> new species	
14(12)	Head with 10–22 short stout setae on vertex; prospinasternum vestigial, spina present . . . . . <i>spiniceps</i> (Hood)	
	Head with 4–6 short, stout setae on vertex; prospinasternum vestigial, spina absent. . . . . <i>crassus</i> (Hinds)	
15(9)	Abdominal tergites with small tuberculate scallops in a row about as large as median campaniform sensilla (Fig. 10); vertex of head with 9–12 short spine-like setae . . . . . <i>crenulatus</i> (Hood)	
	Abdominal tergites without tuberculate scallops; vertex of head with fewer short, stout setae . . . . .	16
16(15)	Abdominal sternites with scalloped striae, posterior row lobe-like and overlapping posterior margin; antennal segment II prolonged laterally, lateral margin concave; body and legs brown, tarsi yellow . . . . . <i>lenape</i> (Hood)	
	Abdominal sternites with tuberculate scallops and posteromarginal lobes; antennal segment II strongly angulated laterally, lateral margin diagonal and somewhat straight or slightly convex ; abdomen yellow, pterothorax yellow or shaded pale brown head brown in sharp contrast to yellow prothorax, legs yellow . . . . . <i>nigriceps</i> (Hood)	
17(1)	Mesonotum, metanotum and abdominal tergites and sternites with many short, stout setae . . . . .	18
	Mesonotum, metanotum and abdominal tergites and sternites with few bristle-like or short, stout setae . . . . .	20
18(17)	Abdominal sternites III–VII with large oval glandular areas, on III 50–62 $\mu\text{m}$ wide, 30 $\mu\text{m}$ long; head brown, body and legs yellow . . . . . <i>sericatus</i> (Hood)	
	Abdominal sternites III–VII with small oval or circular glandular areas, on III less than 30 $\mu\text{m}$ wide; coloration various. . . . .	19
19(18)	Head with about 30 short, stout setae, abdominal tergite I with 10–20 short stout setae; head, thorax and abdomen yellow . . . . . <i>vestis</i> (Hood)	
	Head with 40 or more short stout setae, abdominal tergite I with 30 or more short, stout setae; head brown or light brown, rest of body yellow or pale brown . . . . . <i>texasus</i> (Andre)	
20(18)	Basantra with short, stout setae; head with 28–37 short stout setae on vertex; body yellow, except head and abdominal segment IX brown . . . . . <i>fulvus</i> (Moulton)	
	Basantra lacking setae; other characters various. . . . .	21
21(20)	Fore tibia with well developed outer distal process . . . . .	22
	Fore tibia lacking outer distal process . . . . .	23
22(21)	Head with 22–32 short stout setae on vertex; lateral margin of vertex about 24 $\mu\text{m}$ long, about 2/3 as long as compound eye . . . . . <i>sensitivus</i> (Andre)	
	Head with 4–6 stout setae on vertex; lateral margin of vertex about 12 $\mu\text{m}$ long, about 1/3 as long as compound eye. . . . . <i>mexicanus</i> (Crawford)	
23(21)	Mesosternal furcal invaginations separated by about width of mesothoracic coxa or farther apart; prospinasternum vestigial (Fig. 16); abdominal sternites lack small posteromarginal lobes . . . . .	24
	Mesosternal furcal invaginations separated by about 1/2 width of mesothoracic coxa; prospinasternum developed (Fig 17); abdominal sternites with small posteromarginal lobes . . . . .	25
24(23)	Head with 12–16 short stout setae on vertex; spina of vestigial prospinasternum present as apodeme (Fig 16) <i>spiniceps</i> (Hood)	
	Head with 4–6 short, stout setae on vertex; spina of vestigial prospinasternum absent. . . . . <i>crassus</i> (Hinds)	
25(23)	Abdominal tergites with row of tuberculated scallops; pterothorax and anterior abdominal segments yellowish, abdominal segments brown posteriorly . . . . . <i>crenulatus</i> (Hood)	
	Abdominal tergites lacking tuberculated scallops; body brown . . . . . <i>lenape</i> (Hood)	

## *Chirothrips* Haliday

*Thrips* subgenus *Chirothrips* Haliday 1836: 444. Type Species: *Thrips (Chirothrips) manicata* Haliday, by monotypy.  
*Chirothrips*: Amyot and Serville 1843.

**Female.** Macropterous or rarely brachypterous. Antennal segment I not enlarged and less than 2.5 times as wide base of II; II symmetrical, asymmetrical, apical part angulate or produced laterally, thin seta on apex of angulation or process or 1 or 2 setae subapical on lateral margin. Head slightly to greatly produced anterior of eyes; vertex with 12 or fewer pairs of short setae, venter with normal bristle-like setae. Pronotum with 2 pairs of well developed posteroangular setae, and relatively few short discal setae; basantra membranous, setae absent; prospinasternum a sclerotized band with conical spina. Fore tibia without outer apical process. Mesonotum with bristle-like median setae far anterior of posterior margin; posterior setae on margin or slightly anterior; mesosternal furcal invaginations approximated. Metanotum with 2 pairs of bristle-like setae. Abdominal tergites with sculpture lines oriented transversely or anastomosing; tergites with posteromarginal lobes, or continuous transverse flange, extending from posterior margin or slightly overlapping tergite. Abdominal sternites with or without posteromarginal flange or lobes. Ovipositor usually well developed.

**Male.** Brachypterous. Smaller than females. Head without ocelli; mesosternal furcal invaginations slightly separated in male of *C. aculeatus* and in occasional male of other species; other anatomical structures may differ from those of females in shapes and sizes, or may be present or absent. Glandular areas present on abdominal sternites.

**Comments.** With the assignment of 16 species previously in *Chirothrips* to *Arorathrips*, one to *Konothrips* and one to *Oelschlaegera*, 17 species remain in this genus in the New World. *Arorathrips* and *Konothrips* have separated mesosternal furcal invaginations, enlarged antennal segment I, and segment II is strongly angulate or prolonged anterior laterally, with an apical or subapical sense cone or seta. In *Chirothrips*, the invaginations of the mesosternal furca are not separated (except for males of some species), antennal segment I is not enlarged, segment II is symmetrical or asymmetrically angulate or produced anterior laterally and with small apical or subapical setae. The differences between *Chirothrips* and *Oelschlaegera* are discussed in the comments for the latter genus. The adventive species are *Chirothrips aculeatus* Bagnall, *C. hamatus* Trybom and *C. manicatus* Haliday from Europe, and *C. frontalis* Williams, possibly from southern Africa (although described from Argentina).

### *Chirothrips hemingi* sp.n.

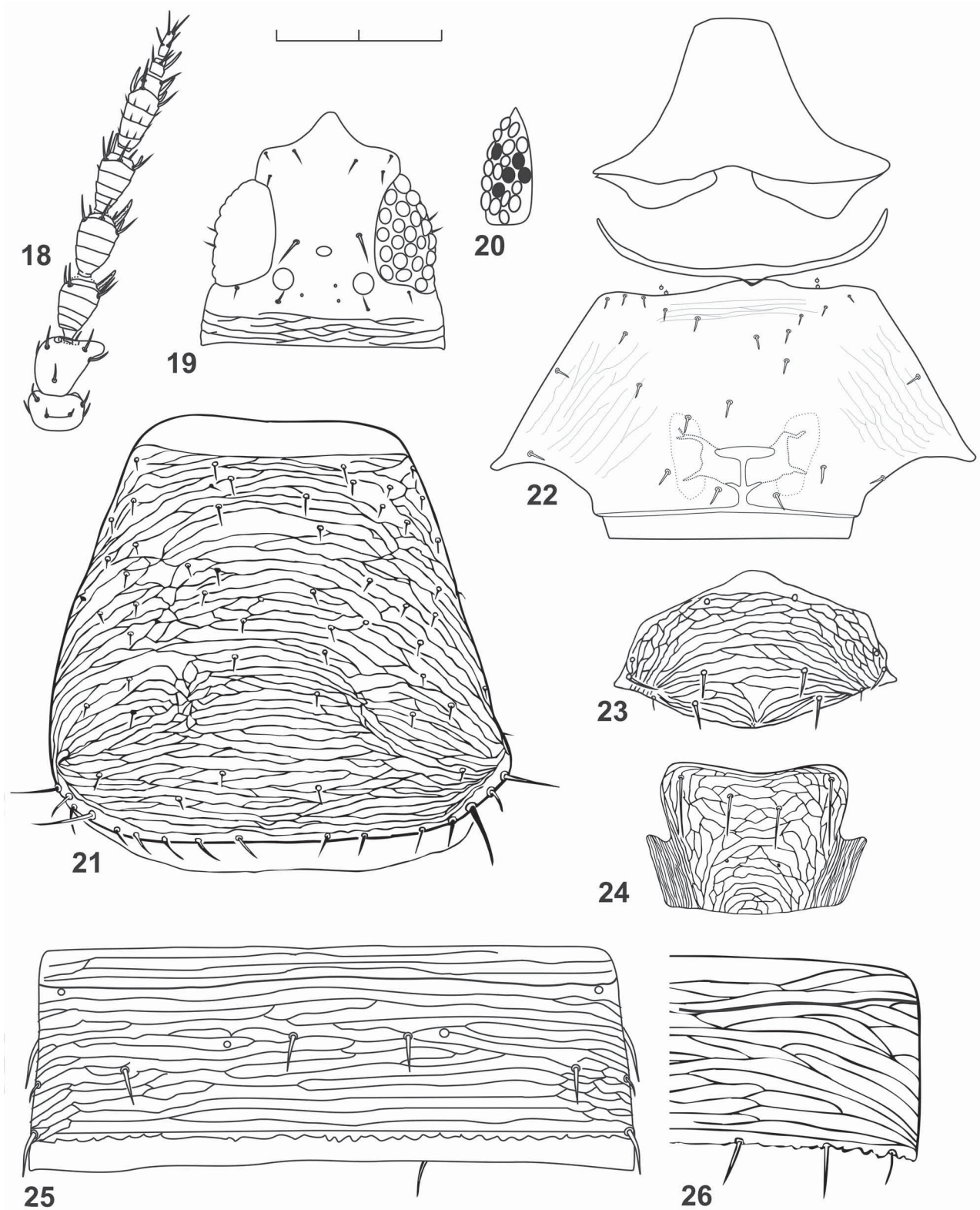
(Figs 18–30)

**Female.** Macropterous. Body brown with orange-red internal pigments, or abdomen yellowish brown with posterior three segments darker brown; legs brown except fore tarsi yellow, mid- and hind tarsi yellow or yellowish brown, fore tarsi distally yellow, brown basally; ocellar crescent red; fore wings light yellow, distally light brownish yellow, fore- and hind vein darker yellow; body setae brown, fore wing setae yellow or brownish yellow; antenna brown except segment III light brown or yellowish brown with pedicel pale, II with lateral process yellowish brown.

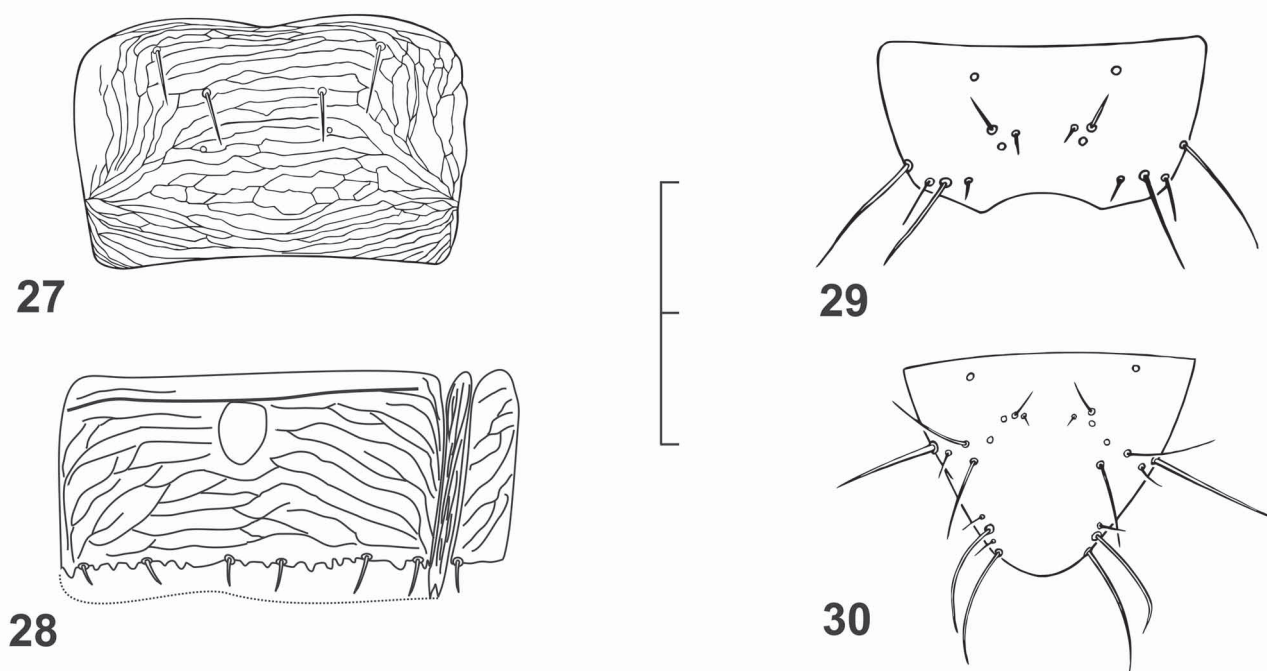
**Antenna** (Fig. 18): Segment I about twice as wide as base of segment II; segment II with inner margin convex, lateral margin diverging from base distally to subapical seta or initially diverging and then bulging outward to subapical seta and projecting laterad as a subtruncate, blunt or pointed, sclerotized process; segments IV and V gradually widening distally to position of subapical setae; segment VIII longer than VII; segments III and IV each with simple sense cone; inner sense cone of segment V longer than outer sense cone, inner sense cone on segment VI in distal 1/3 of segment.

**Head** (Fig. 19): Longer than wide, prolonged anterior of eyes, lateral margin anterior of compound eyes short, extending to rounded angle or margin curved anteromedial, compound eye about twice as long as occiput, occiput with transverse sculpture lines or anastomosing lines, between and anterior of compound eyes without sculpturing; 6–8 short setae on vertex; ocellar setae slightly anterior, laterad or posterior of anterior ocellus; postocular setae minute, 1 posterior of each posterior ocellus, 2 just posterior of eyes; usually 3–4 minute medial pores between first PO setae and posterior ocelli; mouthcone broadly conical, rounded at apex, shorter than head.





**FIGURES 18–26.** *Chirothrips hemingi* sp. n., holotype female. (18) right antenna; (19) head, dorsal aspect; (20) right compound eye, ventral aspect; (21) pronotum; (22) pro- and mesosterna; (23) mesonotum; (24) metanotum; (25) abdominal tergite V; (26) abdominal segment IV, sternite and pleurite IV. Scale bar 100µm.



**FIGURES 27–30.** *Chirothrips hemingi* sp. n., paratype male. (27) metanotum; (28) abdominal sternite IV; (29) abdominal tergite IX; (30) abdominal tergite X. Scale bar 100µm.

**Pronotum** (Fig. 21): Subtrapezoidal, anterior margin considerably shorter than posterior margin, wider than long, sculptured with transverse lines or anastomosing; 41 (44–49) short, discal setae in 2 submedial rows and submarginally, with medial and 2 submedial setae-less areas; 2 pairs of well developed posteroangular setae; posteromarginal setae 8–9, medial pair usually slightly longer than others. **Prosternum** (Fig. 22) with basantra membranous, finely striate-rugulose, without setae; ferna divided. **Mesonotum** (Fig. 23): With transverse sculpturing or partially reticulated; anteromedian pair of campaniform sensilla rather far apart; median setae about aligned with lateral setae, posterior setae slightly anterior of margin. Mesosternal spinula absent (Fig. 22). **Metanotum** (Fig. 24): With transverse sculpture lines or reticulated with recticles transversely oriented medially, arched lines in posteromedial part, lateral sculpture lines longitudinally aligned; median pair of setae in anterior 1/4 of notum, about 42 µm long, shorter than lateral pair; 2 campaniform sensilla present. **Legs**: Fore femora enlarged, with series of ridges on dorsal surface, apical margin reflected; fore tibiae apically truncate.

**Fore wings**: Straight, gradually narrowed distally to blunt apex; 22 (25–26) costal setae, those at midlength about 3/5 as long as width of wing; 27 anterior fringe cilia, mostly straight, few slightly wavy; fore vein with 6 setae in proximal 1/2 and 2–3 setae in distal 1/2; hindvein with 6–7 setae; clavus with 5 veinal and 1 discal setae.

**Abdomen**: Tergites (Fig. 25) sculptured with transverse or anastomosing striae, 12–15 lines medially posterior of antecostal ridge, none differentiated from others; median setae on tergite I minute, on tergites II–VII subequal to D2 setae, slightly anterior to median campaniform sensilla on tergite VIII, between or slightly anterior to median campaniform sensilla on tergites II–VII; area between median campaniform sensilla and antecostal ridge with 4–5 striae on tergites IV–VII; posteromarginal flange short, subequal to distance between sculpture lines, margin normally undulating or irregular; tergite IX with 2 pairs of campaniform sensilla; tergite X long, conical, 1.5–1.75 times longer than tergite IX, with 1 pair of campaniform sensilla just anterior of B1 setae. Pleurotergites with posteromarginal teeth. **Sternites** (Fig. 26) with transverse lines, none differentiated from others except antecostal ridge; sternite I with 2–4 anteromedial setae. Sternite II with 2 or 3 pairs of posteromarginal setae, sternites III–VII with 3 pairs of posteromarginal setae on margin except B1 setae on sternite VII anterior of posterior margin, closer to B2 setae than to each other; small lobes on posterior margins of sternites II–VII; ovipositor 267 (247–272) µm long.

**Measurements of holotype (and female paratypes)**. Body length: 1.74 (2.06–2.17 distended) mm. Other measurements in µm. Antenna: total length 252 (245–250); length, width of antennal segment I 22 (22–24), 35 (37); II 37 (37), 42 (40–42); III 40 (37–40), 24 (24–27); IV 40 (35–40), 24 (24–27); V 37 (32–35), 22 (22–23); VI

49 (48–50), 20 (20); VII 10 (12), 10 (7); VIII 17 (15–17), 6 (5). Head: length from interantennal projection 151 (153–161); produced marginal part anterior of eye 17 (15); eye 74 (74–79) long; occiput 37 (37) long. Pronotum 235 (203–230) long, 274 (247–272) wide. Fore wing 1099 (1025–1062) long, 62 (62) wide at midlength. Abdominal segment IX (72–82), X 133 (124–148). Setae: ocellar setae about 15 long; posteroangular setae outer pair 43 (42–57), inner pair 37 (37–50); median metanotal setae about 17 long; abdominal tergite IX with B1 setae 126 (114–131), B2 setae 138 (114–128); tergite X with B1 setae 131 (128–137), B2 setae 124 (117–124).

**Male.** Brachypterous. Similar to females in color but smaller. *Antenna*: Similar to females. *Head*: Similar to females except without ocellus; vertex with 8 short setae, ocellar setae at midlength or slightly posterior.

*Pronotum*: Sculptured with transversely oriented lines; about 49 short, discal setae in 2 submedial rows and on submargin; 2 pairs of developed posteroangular setae, and about 10 posteromarginal setae. *Metanotum* (Fig. 27): Subrectangular, transversely sculptured; median setae in anterior 1/4 of notum, lateral setae posterior of anterior margin; 2 campaniform sensilla at about midlength of notum.

*Abdomen*: Tergal posteromarginal flange subequal to length of 2 tergal, interstrial spaces or slightly longer, margin with lobes or teeth. Abdominal tergite IX (Fig. 29) with B1 setae posteromedial of longer D1 setae, B2 setae posterolateral of B1 setae, posterolateral setae and midlateral setae long, a shorter seta between posterolateral and midlateral setae; a campaniform sensillum between D1 and B1 setae or posterior of D1 setae, another pair near anterior margin of tergite. Sternites with conical or low lobes on posterior margins; sternites III (Fig. 28) and IV each with a small circular or slightly oval glandular area 12–15 µm wide, smaller than distance between B1 setae.

**Measurements of male paratype.** Body length 1.33 mm distended. Other measurements in µm. *Antenna*: total length 201; length, width of segment I 20, 32; II 27, 25; III 35, 23; IV 35, 24; V 27, 22; VI 37, 18; VII 8, 7; VIII 12, 5. Head: length from interantennal process 131; eye 62 long; occiput 35 long; width at occiput 117. Pronotum 205 long, 225 wide. Setal lengths: posteroangular setae outer pair 24–30; inner pair 37; tergite IX D1 setae 27–35 long; B1 setae about 10 long; B2 setae about 10 long; posterolateral setae 84–86 long; midlateral setae 82–91 long.

**Type material.** Holotype female, **Canada, Alberta**, Jasper, 24-VI-55, grass, R. M. Bohart (UCD). Paratypes: 1 female with same data as holotype; 4 females, Cypress Hills Provincial Park, Alberta, sweeping grass and forbs, 30-VI-69, B. S. Heming; 3 females, Mt. Norquay, Banff, Alberta, 60001, 25-V-60, W. W. Moss; 1 female, Whitemud Hills, Alberta, grass, 5-VII-70, B. S. Heming; 27 females, 7 males, Osoyoos, British Columbia, Canada, grass, 30-VII-80, G.A.P. Gibson. Paratypes deposited in CNC, UASM, UCD and USNM.

**Distribution.** Canada (Alberta, British Columbia).

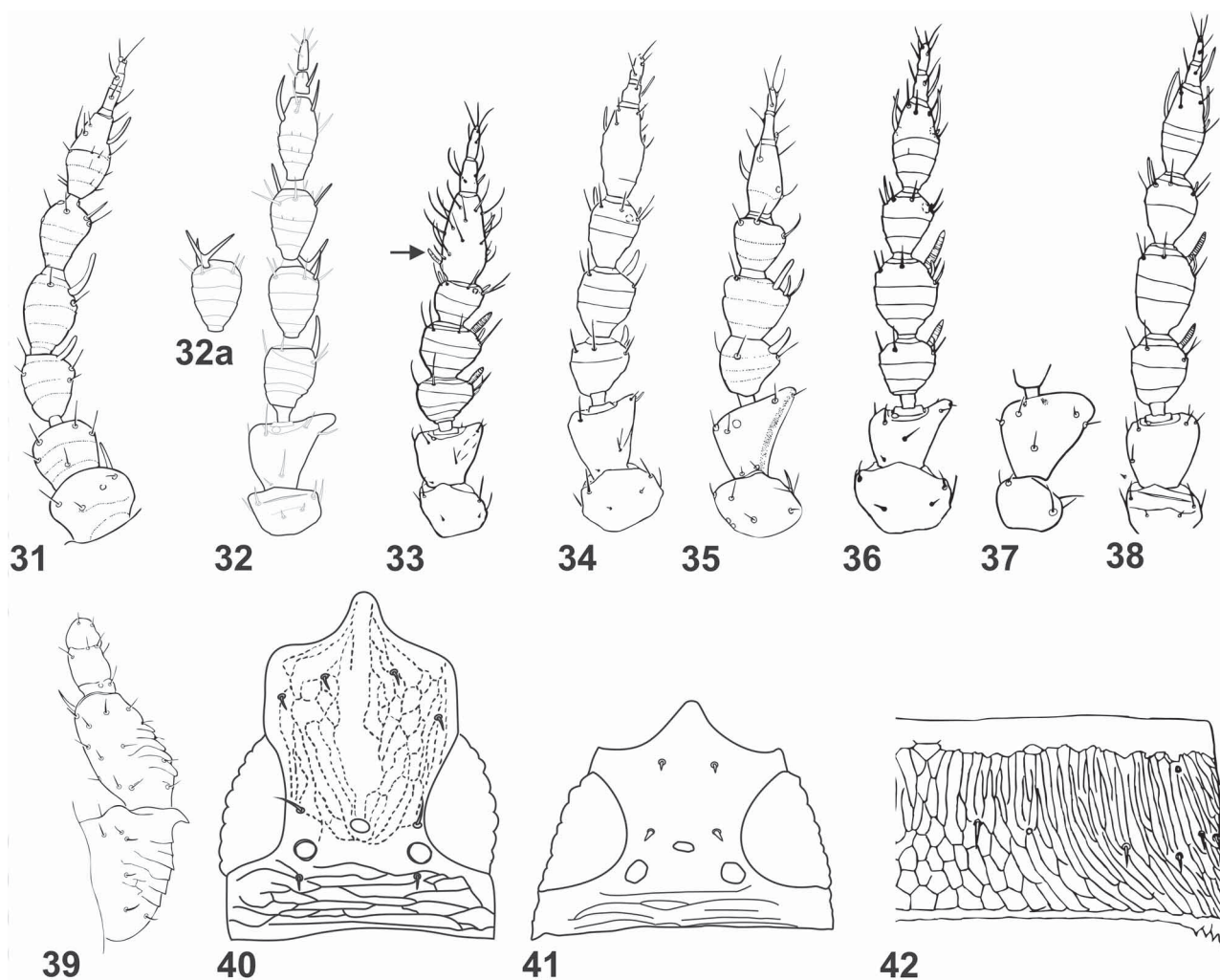
**Etymology.** Named after Dr. Bruce Heming, University of Alberta, Edmonton, for providing thrips material for this project and in recognition of his work on the functional morphology and development of Thysanoptera.

**Comments.** This species resembles *C. molesta* Priesner from the Palearctic Region. The apex of the lateral process of antennal segment II of *C. molesta* has a translucent gland, outer sense cone on segment V is longer than inner sense cone, and abdominal tergites lack complete posteromarginal flange but have separated lobes with acuminate apex or lobes that are low and indistinct. The apex of the lateral process of antennal segment II of *C. hemingi* is sclerotized, inner sense cone on segment V is longer than outer sense cone, and abdominal tergites have short, complete posteromarginal flange normally with lobed margin. In the Nearctic Region, *C. hemingi* resembles *C. productus* but is readily separated by the position of the median tergal setae on the abdomen.

The holotype and paratype from Jasper have only 2 pairs of posteromarginal setae on abdominal sternite II and the apex of lateral process of antennal segment II is subtruncate. The paratypes from Mt. Norquay and Cypress Hills Provincial Park have normally 3 pairs of posteromarginal setae on sternite II and antennal segment II has a bluntly pointed process. Antennal segment II is usually tilted and the lateral process appears to be narrower and more pointed.

The convex lateral margins of antennal segment II of some specimens from Osoyoos, British Columbia are quite different from the gradually diverging forms from Alberta and they appear to be a different species. However, the shapes of the lateral margin are variable in a long series of specimens from Osoyoos and part of the range of variation is similar to those of the Alberta specimens. Except for this difference, the other anatomical characters are similar. Description of the male is based on the Osoyoos material.





**FIGURES 31–42.** *Chirothrips* and *Konothrips* species. Figs 31–38, right antenna (dorsal aspect unless otherwise noted) of *Chirothrips* spp. (31) *C. hamatus*; (32) *C. aculeatus*, (32a) ventral aspect of segment IV; (33) *C. insolitus* (after zur Strassen 1960) (arrow indicates location of inner sense cone of segment VI); (34) *C. andrei* (after zur Strassen 1974); (35) *C. praeocularis*; (36) *C. manicatus* (after zur Strassen 1959); (37) *C. cuneiceps*; (38) *C. simplex* (after zur Strassen 1967a). (39) *C. hamatus*, left foreleg. (40) *C. alexandrae*, head, dorsal aspect. (41) *C. manicatus*, head, dorsal aspect. (42) *Konothrips tuttlei*, abdominal tergite.

### List of *Chirothrips* species in the Americas

#### *Chirothrips aculeatus* Bagnall

*Chirothrips aculeatus* Bagnall 1927: 567.

*Chirothrips moultoni* Post 1961: 137 **syn.n.**

**Distribution:** United States (CA, ID, OR, UT, WA), Europe (zur Strassen 1960: 167).

**Comments:** Although Post (1961) states that *C. moultoni* Post has simple sense cones on antennal segments III and IV, the type specimen has a forked sense cone on IV and a simple sense cone on III, and cannot be distinguished from *C. aculeatus* (New Synonymy).

#### *Chirothrips alexandrae* Stannard

*Chirothrips alexandrae* Stannard 1959: 65

**Distribution:** Canada (AB), United States (CO, NB, ND, SD) (zur Strassen 1974)



***Chirothrips andrei* zur Strassen**

*Chirothrips andrei* zur Strassen 1974: 198.

**Distribution:** Canada (AB, ON), United States (NB, WY).

**Comments:** This species has been misidentified at least once in USA as *C. frontalis*.

***Chirothrips cuneiceps* Hood**

*Chirothrips cuneiceps* Hood 1940: 547.

**Distribution:** Canada (AB) (Chaisson 1986), United States (MN, NY).

***Chirothrips falsus* Priesner**

*Chirothrips falsus* Priesner 1925: 312; zur Strassen 1967a: 28.

*Chirothrips falsus* var. *adusta* Priesner 1925: 313; Hood 1939a: 463.

*Chirothrips simplex* Hood 1927b: 128; Hood 1939a: 463 (misidentification).

**Distribution:** Canada (AB, SK) (Chaisson 1986), United States (AZ, IL, IA, KS, NM, TX, UT, WY), Mexico.

**Comments:** For many years, *C. simplex* was confused with this species, and collections may still include misidentified specimens.

***Chirothrips frontalis* Williams**

*Chirothrips frontalis* Williams 1914: 51

*Chirothrips salcatus* John 1922: 345; Hood 1953: 115.

**Distribution:** Argentina, Kenya, South Africa, Australia (zur Strassen 1960).

**Comments:** According to Mound and Palmer (1972) *C. frontalis* Williams resembles *C. bradleyi* Hood (= *praeocularis* Andre) and is of American origin. However, it lacks diagonal ridges on antennal segment II, and median longitudinal ridge and other irregular longitudinal markings present on the head of *C. praeocularis*. Jacot-Guillarmod (1971) listed *C. frontalis* for the United States (Wyoming) but the source for this record was not indicated. One specimen previously determined as this species from Wyoming was located in the UCD collection and could be the basis for this record. However, this specimen is a misidentification of *C. andrei*. A record from Michoacan, Mexico (Johansen & Mojica-Guzman 1996) was not examined and therefore was not listed in the distribution.

***Chirothrips hemingi* sp. n.**

**Distribution:** Canada (AB)

***Chirothrips hamatus* Trybom**

*Chirothrips hamata* Trybom 1895: 187.

**Distribution:** Canada (AB) (Heming 1985), Europe.

***Chirothrips insolitus* Hood**

*Chirothrips insolitus* Hood 1915: 11.

**Distribution:** United States (AR, FL, IL, MD, NJ, NY, TN, TX) (Jacot-Guillarmod 1971; Beshear 1973).

**Comments:** The form of antenna segment VI is different from that of all its congeners. The lateral margin of the vertex anterior of the compound eyes are well produced, up to 20 µm long, but is less than 1/3 as long as the compound eye. The abdominal tergal posteromarginal flanges are lobed marginally and marginal lobes are also present on sternites.

***Chirothrips manicatus* (Haliday)**

*Thrips (Chirothrips) manicata* Haliday 1836: 444.

*Chirothrips antennatus* Osborn 1883: 154; Uzel 1895: 80.

**Distribution:** Canada (AB, BC, NS, NT, ON, QC, YT) (Chaisson 1986), United States (AK, CA, CT, ID, IL, IA, MA, MD, ME, MI, MN, NE, NM, NY, NV, OH, OR, PA, UT, VA, WA), Argentina, Colombia, Europe, China, Japan, Taiwan, Australia, New Zealand,

**Comments:** One of the widely dispersed species in the world. The shape of antennal segment II is variable.

***Chirothrips orizaba* Hood**

*Chirothrips orizaba* Hood 1938: 357.

**Distribution:** Mexico.

**Comments:** This species is known only from the female holotype and closely resembles *C. productus*.

***Chirothrips patruelis* Hood**

*Chirothrips patruelis* Hood 1940: 550.

**Distribution:** Canada (AB, BC, NT, SK) (Chaisson 1986), United States (AK, CA CT, HI, IA, ME, ND, NM, NY, SD), Peru (Jacot-Guillarmod 1971).

***Chirothrips praeocularis* Andre**

*Chirothrips praeocularis* Andre 1941: 451.

*Chirothrips bradleyi* Hood 1941: 142; Stannard 1968: 300.

**Distribution:** United States (GA, FL, LA, MA, MD, NJ, SC, TX) (Jacot-Guillarmod 1971; Beshear 1973).

***Chirothrips productus* Hood**

*Chirothrips productus* Hood 1927b: 126.

**Distribution:** United States (AZ, CO, ID, ND, NM, NV, UT) (Jacot-Guillarmod 1971; Huntsinger & Balsbaugh 1982).

***Chirothrips propinquus* zur Strassen**

*Chirothrips propinquus* zur Strassen 1967a: 35.

**Distribution:** United States (AZ).

**Comments:** Females of this species are brachypterous and lack ocelli. Brachypterous females also occur in *C. azoricus* zur Strassen (1981) from Azores and occasionally in *C. manicatus*.

***Chirothrips secalis* Moulton**

*Chirothrips secalis* Moulton 1935: 173.

**Distribution:** United States (CA, WY).

***Chirothrips simplex* Hood**

*Chirothrips simplex* Hood 1927b: 128; zur Strassen 1967a: 38.

**Distribution:** Canada (AB), United States (AZ, CA, CO, IA, KS, NE, ND, NM, OK, SD, TX, WY), Mexico.

**Comments:** This species was misidentified as *C. falsus* until further defined by zur Strassen (1967a).

**Key to females of species of *Chirothrips* in the Americas**

- 1 Antennal segment II symmetrical (Fig. 31); fore femur with anterior margin strongly recurved dorsally (Fig. 39).....2  
Antennal segment II slightly angulated (asymmetrical) to produced laterally at apex (Figs 18, 32–38); fore femur with various anterior margins. ....3
- 2(2) Antennal segment III and IV each with a forked sense cone ..... *secalis* Moulton  
Antennal segment III and IV with simple sense cones ..... *hamatus* Trybom
- 3(1) Antennal segment IV with forked sense cone (Fig. 32a); abdominal tergites II–VIII with posteromarginal lobes .....  
..... *aculeatus* Bagnall  
Antennal segment IV with simple sense cone (Fig. 18); abdominal tergites with posteromarginal flange of various forms. ....4
- 4(3) Head lacks ocelli; brachypterous; antenna and body brown, legs brown with tarsi yellow ..... *propinquus* zur Strassen  
Head with ocelli; macropterous; color various .....5
- 5(4) Antennal segment VI with inner sense cone on basal 1/5–1/3 of segment (Fig. 33); segment III wider than long; segments VII+VIII slightly shorter to about as long as VI. .... *insolitus* Hood  
Antennal segment VI with inner sense cone in distal 1/2 of segment; segment III as long as or longer than wide; segments VII+VIII about 2/3 as long as VI .....6
- 6(5) Head strongly produced anterior of compound eyes, lateral margin of vertex anterior to eyes 1/3–2/3 as long as eyes, as long as or longer than antennal segment I (Fig. 40) .....7  
Head less produced anterior of compound eyes, lateral margins of vertex anterior to eyes 1/4 as long as eyes or shorter, shorter than antennal segment I (Fig. 41) .....10

- 7(6) Lateral margin of vertex anterior to compound eyes forming an obtuse angle with antennal socket; head lacking median longitudinal ridge anterior of fore ocellus; antennal segment II with 0–1 ridge. . . . . 8  
 Lateral margin of vertex anterior of compound eyes distally forming a blunt acute angle with antennal socket; head with longitudinal ridge anterior of fore ocellus; antennal segment II with 2 parallel ridges . . . . . 9
- 8(7) Antennal segment II prolonged laterally with apical seta, lateral margin concave, without ridge; vertex of head smooth; abdominal sternites III–VI lack submarginal posteromarginal teeth . . . . . *frontalis* Williams  
 Antennal segment II angulate laterally to rather sharp point, one subapical seta on rather straight lateral margin, a ridge between dorsal seta and subbasal seta; vertex of head with weak reticulation; abdominal sternites II–VI with submarginal posteromarginal teeth . . . . . *alexandrae* Stannard
- 9(7) Antennal segment II asymmetrical, but not strongly produced laterally, margin straight (Fig. 34); pronotal inner and outer posteroangular setae subequal in length; abdominal sternites II–IV with row of well developed posteromarginal lobes; fore wings completely brown. . . . . *andrei* zur Strassen  
 Antennal segment II prolonged apico-laterally, lateral margin concave before blunt apex (Fig. 35); pronotal outer posteroangular setae more than 1.5 times longer than inner setae; abdominal sternites with or without low, sparse posteromarginal lobes; fore wings pale basally, gradually pale gray distally. . . . . *praeocularis* Andre
- 10(6) Antennal segment II distinctly produced laterally, with lateral margin terminating distally in a distinct conical or bulbous process, margin normally concave (Fig. 36). . . . . 11  
 Antennal segment II asymmetrical or somewhat produced laterally, lateral margin straight or slightly convex (Fig. 37). . . . . 15
- 11(10) Seta on lateral conical process of antennal segment II at apex (Fig. 36); abdominal sternite with posteriormost stria distinct from those anterior to it. . . . . *manicatus* (Haliday)  
 Setae on lateral conical or bulbous process of antennal segment II subapical (Figs 18, 37); other characters various . . . . . 12
- 12(11) Antennal segment II with apex of lateral process broadly rounded, with small subapical setae in concave margin, farther than its length from apex (Fig. 37); lateral margin of head anterior of compound eyes curved anteromedially forming a broadly curved obtuse angle with antennal socket. . . . . *cuneiceps* Hood  
 Antennal segment II with apex of lateral process conical or narrowly rounded, subapical seta positioned about its length from apex (Fig. 18); lateral margin of head anterior of compound eyes straight to arched, angle with antennal socket usually more abrupt. . . . . 13
- 13(12) Abdominal tergite VIII with median setae anterior of median campaniform sensilla; abdominal segment X 1.6–1.7 times longer than IX; abdominal sternites with uniform transverse striae. . . . . *hemingi* new species  
 Abdominal tergite VIII with median setae posterior of campaniform sensilla; abdominal segment X less than 1.5 times length of IX; abdominal sternites with scalloped sculpture or posteriormost stria distinctly stronger than anterior striae. . . . . 14
- 14(13) Mesosternum with anterior margin of sclerotized part rather straight; abdominal sternites II–IV with striae scalloped, uniformly developed; antennal segment I with transverse ridge between distal dorsal setae (cf. Fig. 32); head without sculpturing anterior of fore ocellus. . . . . *productus* Hood  
 Mesosternum with anterior margin of sclerotized part strongly emarginated; abdominal sternites II–IV with subapical stria more strongly indicated than striae anterior to it; antennal segment I lacks transverse ridge between distal, dorsal setae; head with sculpturing anterior of fore ocellus. . . . . *orizaba* Hood
- 15(13) Antennal segment I with dorsal transverse ridge (Fig. 38); segment II angulate laterally or asymmetrical, lateral margin distally terminating in rounded or blunt angle with anterior margin; subapical stria on abdominal sternites II–VI similar to striae anterior to it. . . . . 16  
 Antennal segment I without dorsal transverse ridge; segment II moderately asymmetrical, lateral margin mostly straight, slightly diagonally slanted distally; abdominal sternites II–VI with a subapical stria more distinct than striae anterior to it . . . . . *patruelis* Hood
- 16(15) Outer sense cone on antennal segment V longer than inner sense cone; lateral margin of vertex anterior of compound eye normally 8–12  $\mu\text{m}$  long. . . . . *falsus* Priesner  
 Outer sense cone on antennal segment V shorter than inner sense cone; lateral margin of vertex anterior of compound eye normally 3–5  $\mu\text{m}$  long. . . . . *simplex* Hood

## Key to males of species of *Chirothrips* in the Americas

Males not known for *C. andrei*, *C. alexandrae*, *C. orizaba*, *C. patruelis* and *C. propinquus*.

- 1 Lateral margin of vertex anterior of compound eye about 24  $\mu\text{m}$ , about 1/3 as long as eye; antennal segment II produced laterally; segment III wider than long, segments VII+VIII as long or longer than VI . . . . . 2  
 Lateral margin of vertex anterior of compound eye shorter than 20  $\mu\text{m}$ , 1/4 as long as eyes or shorter; antennal segment II symmetrical or laterally asymmetrical, angulate or produced; segment III about as long as wide or longer; segments VII+VIII shorter than VI. . . . . 3
- 2(1) Abdominal tergites with scalloped sculpture; sternites without posteromarginal lobes; pronotum with weak sculpture; thorax and anterior part of abdomen yellow. . . . . *praeocularis* Andre  
 Abdominal tergites with transverse striae or anastomosing sculpture; sternites with posteromarginal lobes; pronotum with series of short transverse sculpture lines; pronotum and abdomen brown, pterothorax yellow. . . . . *insolitus* Hood
- 3(1) Abdominal sternites with posteromarginal flange in complete transverse band, posterior margin irregular with teeth of various sizes; sternites III–VI with B1–B2 setae anterior of posterior margin; thorax yellow, abdomen brown, fore legs yellow, mid and

	hind legs brown with tarsi yellow . . . . .	<i>frontalis</i> Williams
	Abdominal sternites lack transverse posteromarginal flange, lobes present or absent; sternites III–VI with setae on posterior margin; various coloration. . . . .	4
4(3)	Abdominal tergites with posteromarginal lobes; pronotum with short, transverse sculpture lines; lateral margin of vertex anterior of compound eyes curved. . . . .	<i>aculeatus</i> Bagnall
	Abdominal tergites with continuous posteromarginal flange, margin of flange lobed or irregular; other characters various . . .	5
5(4)	Antennal segment II symmetrical, not angulate or produced laterally; head barely produced anterior of eyes; abdominal sternites III–VII with glandular areas . . . . .	6
	Antennal segment II asymmetrical, angulate or produced laterally; other characters various . . . . .	7
6(5)	Glandular areas on abdominal sternites III–VII transversely oblong, about 3 times wider than long, about 1/2 as wide as sternite; median setae on tergite VIII posterior of median campaniform sensilla. . . . .	<i>hamatus</i> Trybom
	Glandular areas on sternites III–VII slightly wider than long, about 1/3 as wide as sternites; median setae on abdominal tergite VIII anterior of median campaniform sensilla . . . . .	<i>secalis</i> Moulton
7(5)	Abdominal sternites III–V each with small, circular glandular area. . . . .	8
	Abdominal sternites III–VI, III–VII or III–VIII each with various glandular area . . . . .	9
8(7)	Antennal segment I with transverse ridge, segment II with 2 apical or subapical setae, dorsal seta near antennal socket absent; median setae on abdominal tergites II–VIII posterior of median campaniform sensilla . . . . .	<i>productus</i> Hood
	Antennal segment I lacking transverse ridge, segment II with 1 subapical seta and 1 dorsal seta near antennal socket; median setae on abdominal tergites II–VIII slightly anterior or between median campaniform sensilla . . . . .	<i>hemingi</i> sp.n.
9(7)	Antennal segment II produced laterally with apex broadly rounded . . . . .	<i>cuneiceps</i> Hood
	Antennal segment II only angulate laterally or produced with apex pointed or blunt . . . . .	10
10(9)	Antennal segment I with dorsal, transverse ridge; segment II laterally angulate, margin straight or slightly concave basally .	11
	Antennal segment I lacks dorsal, transverse ridge; segment II laterally produced, margin distinctly concave. <i>manicatus</i> Haliday	
11(10)	Abdominal sternites III–VIII with glandular area; antennal segment V with inner sense cone longer than outer sense cone. . . . .	<i>simplex</i> Hood
	Abdominal sternites III–VI or VII with glandular area; antennal segment V with outer sense cone longer than inner sense cone . . . . .	<i>falsus</i> Priesner

## Konothrips Bhatti

*Konothrips* Bhatti 1990: 196. Type species: *Chirothrips tuttlei* zur Strassen by original designation.

Antennal segment I enlarged, more than 2.5 times as wide as base of segment II; segment II prolonged laterally, resembles inverted shoe, a well defined gland protrudes apically over sense cone on apex of the sclerotized part of process. Head with 40 plus short, stout setae anterior of fore ocellus. Pronotum subtrapezoidal, with numerous, short conical setae; without posteroangular setae or two pairs slightly larger than discal setae. Femur truncate apically, distal 1/3 sculptured with longitudinal, ridged lines or reticles (Fig. 46). Mesonotum (Fig 48) with 4–6 conical or spine-like, discal setae in median area far anterior to posterior margin, median pair of posterior setae absent, setae larger than those on pronotum; mesosternal furca invaginations separated by less than 2/5 to about width of metathoracic coxae. Metanotum (Fig. 49) with median pair of conical setae. Fore wings with 1 to few costal setae. Abdominal tergites with submarginal sculpture oriented longitudinally or diagonally (Figs. 42, 50), medially reticulated or transversely striate; 5 pairs of dorsal conical or spine-like setae, those on posterior tergites more elongate; posteromarginal flange narrow, about as wide as length of dorsal setae. Abdominal sternite with submarginal sculpture oriented longitudinally or diagonally; sternal discal setae absent; ovipositor short, 110–136  $\mu\text{m}$  long. Male brachypterous. Smaller than female. Abdominal tergite IX with short B1–B2 setae; sternites III–VII each with glandular areas.

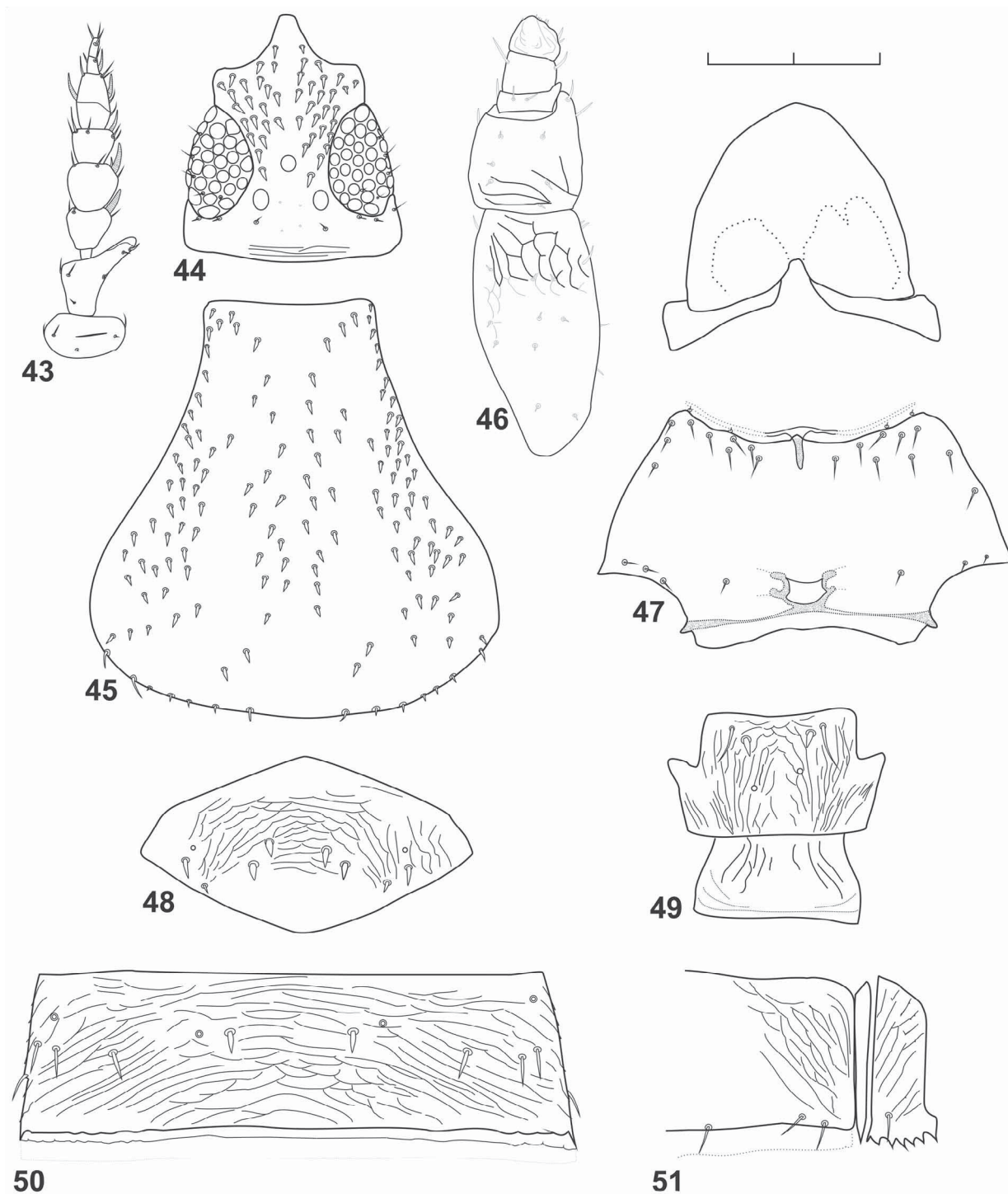
**Comments.** According to Bhatti (1990) *Konothrips* is distinguished by the sculpture on abdominal terga and sterna oriented longitudinally (Fig. 42); costa of fore wing without series of setae, having only a single seta; and ovipositor smooth, lacking teeth. *Konothrips colei*, new species, is intermediate in these structures between *tuttlei*, the type species of genus, and members of *Arorathrips*. In *K. colei* the abdominal tergal sculpturing is diagonally oriented on submargin and transverse or reticulated medially (Fig. 50), and the submarginal, sternal sculpturing is more longitudinally oriented (Fig. 51), the ovipositor is reduced but with sparse teeth, and the fore wing has sparse costal setae. The differences between *Konothrips* and *Arorathrips* are discussed in the comments for *Arorathrips*. The concept of *Konothrips* is revised here to accommodate *K. colei*.



***Konothrips colei* sp. n.**

(Figs 43–51)

**Female.** Macropterous. Body brown, head darker brown than thorax or abdomen pale brown with anterior part and terminal segments darker brown; tarsi yellow, tibiae and femora brown with apical or proximal parts yellow, or fore tibiae mostly yellowish brown, femora and mid- and hind tibiae brown dorsally, yellow ventrally. Setae pale yellow or pale yellowish brown. Fore wing pale yellow or shaded with pale yellowish gray tinge. Antenna brown, segment I darkest brown, segment II light brown with produced part yellowish brown, segment III light brown basally.



**FIGURES 43–51.** *Konothrips colei* sp. n., holotype female. (43) right antenna, dorsal aspect; (44) head, dorsal aspect; (45) pronotum; (46) right foreleg; (47) pro- and mesosterna; (48) mesonotum; (49) metanotum; (50) abdominal tergite IV; (51) abdominal segment IV, sternite and pleurites. Scale bar 100  $\mu$ m.

*Antenna* (Fig. 43): Segment I 2.5–2.9 times wider than base of segment II, with a transverse dorsal ridge; segment II with inner margin rather straight, outer margin strongly diverging laterally from base to blunt process, apex of process with a distinct gland; 1 subapical sense cone slightly extending beyond apical gland, 1 short dorsal and 1 ventral setae just mediad of sense cone, 1 short seta on outer margin about midway between subapical sense cone and base of segment, 1 short dorsal seta near apex of inner margin and another dorsal seta near base of segment, 1 short ventral seta medially and another ventral seta near apex of inner margin; segment III with convex outer margin, slightly longer than wide; segments III and IV each with simple sense cone; outer sense cone on segment V larger than inner sense cone; inner sense cone of segment VI in distal 1/2, extending to apex of segment.

*Head* (Fig. 44): Longer than wide from interantennal process, lateral margin of vertex anterior of compound eye 22–24  $\mu\text{m}$  long, slightly converging to broad angle formed with anterior margin of vertex; eye about two times as long as occiput; head smooth except for several transverse sculpture lines by posterior margin; 46 (43–48) short, stout setae on vertex, ocellar setae similar to setae anterior of fore ocellus, posterolaterad of fore ocellus; postocular setae minute, 1 pair posterior of hind ocelli, 2 near posterior margin of eye, 4 minute pores medially between median-most postocular setae; mouthcone broadly conical, shorter than head.

*Pronotum* (Fig. 45): About as long as broad, with weak short transverse sculpture lines medially; 122 (114–119) short, spine-like setae in medial and two submarginal bands; posteroangular setae not developed, 14 short, spine-like setae on posteromargin. Prosternum (Fig. 47) with basantra partially weakly sclerotized in posteromedial part, without setae, with finely granulose sculpture; prospinasternum a narrow unsclerotized band, spina inserted into mesosternum. *Mesonotum* (Fig. 48): Reticulated; anteromedian campaniform sensilla far apart; median posterior setae positioned near submedian setae, both setae far anterior of posterior margin, conical, larger than other setae on notum and pronotum; often with another pair of smaller, spine-like discal setae. Mesofurca with invaginations separated by 20–24  $\mu\text{m}$ , 3/10 to 2/5 width of mesothoracic coxae (Fig. 47). *Metanotum* (Fig. 49): Sculpture lines longitudinally oriented except medially in arched pattern; median setae conical, as large as submedian setae on mesonotum, in anterior 1/4 of notum, lateral setae bristle-like; pair of campaniform sensilla present. *Legs*: Fore femora with ridged, longitudinally oriented reticles on distal 1/3 (Fig. 46); outer side of fore tibia slightly longer than inner side.

*Fore wings*: Straight, gradually narrowed distally to blunt apex; 5–6 (4–5) costal setae short, 1 basal of first anterior fringe cilia, those at midlength about 3/5 as long as width of wing; 24 (19–20) slightly wavy anterior fringe cilia; fore vein with 5 (3–4) setae in proximal 1/2, 3 (2–3) distal setae; hindvein with 1 (1–2) seta; scale with 4 (4) marginal setae.

*Abdomen*: Tergites with diagonally oriented sculpture lines submarginally, transverse or reticulated medially (Fig. 50); 5 pairs of setae on tergites II–VII, on anterior tergites spine-like, progressively more slender posteriorly; median setae slightly anterior to slightly posterior of median campaniform sensilla, posterior of campaniform sensilla on tergite VIII, on tergite VI about 20  $\mu\text{m}$  long; posteromarginal flange narrow, about 5  $\mu\text{m}$  long, laterally with few marginal teeth; tergite IX with 2 pairs of campaniform sensilla, posterior pair near B1 setae; segment X slightly longer than segment IX, with complete dorsal split, pair of campaniform sensilla near B1 setae. Pleurotergites (Fig. 49) with sparse, teeth-like microtrichia on sculpture lines, posteromarginal flange with margin lobed or toothed. Sternites (Fig. 51) transversely sculptured medially; sculpture lines on submargin diagonal but more longitudinally oriented than on tergites; margins of sternites without processes; anteromedial setae absent from sternite I, sternite II with 2 pairs of posteromarginal setae, sternites III–VII with 3 pairs of posteromarginal setae, median pair on sternite VII anterior of posterior margin; ovipositors about 135 (131–141)  $\mu\text{m}$  long.

**Male.** Unknown.

**Measurements of holotype and (paratype).** Body length 1.64 mm, distended 1.87 mm. Other measurements in  $\mu\text{m}$ . Antenna total length 199 (205) long; length and width of segment I 24 (27), 47 (50); II 37 (37), 30 (32); III 30 (30), 32 (28); IV 27 (27), 32 (32); V 24 (24), 30 (27); VI 35 (35), 24 (20); VII 10 (11), 8 (8); VII 12 (12), 6 (4). Head: Length from interantennal process 148 long, from compound eyes to tip of interantennal process 116 (111) long, lateral margin of vertex from compound eye to broad angulation formed with anterior margin of vertex 22–24 long, compound eye 59 (57) long, occiput 32 (30) long. Pronotum 247 (235) long, 133 (135) wide (based on flattened specimen). Fore wings 884 (843–847) long, 47 (42–44) wide at midlength. Abdominal segment IX 59 (62) long, X 74 (72) long. Setae: Short stout setae on vertex of head 7–10 long, ocellar setae about 10 long, pronotal discal setae about 7 long, submedian mesonotal setae 12–15 long, median metanotal setae about 12 long; abdominal tergite IX with B1 setae 89 long, B2 setae 94 (96) long, B3 setae 106 long; tergite X with B1 setae 104 (101) long, B2 setae 101 (99) long.

**Type material.** Holotype female (USNM); Texas, Comal Co., Guadalupe River State Park, sweeping, 24-IX-88, G. Zolnerowich. Paratype females: 1, Texas, Lubbock Co., Slaton, onion field, 21-VII-86, R. Sites; 3, Texas, Bandera Co., Lost Maples [*sic*, = Maples] State Park, 21-VII-88, G. Zolnerowich. Paratypes deposited in TESB and USNM.

**Distribution.** United States (Texas).

**Etymology.** Named after Charles L. Cole, retired thysanopterist formerly with the Texas Extension Service, Bryan, who provided the type material.

**Comments.** The specimens are mounted in Hoyer's medium and are rather flattened and distended. Thus the body and head measurements may not agree with those of properly mounted specimens. Also, the description of the coloration may differ from differently treated specimens.

## List of *Konothrips* species

### *Konothrips colei* sp. n.

**Distribution.** United States (Texas).

### *Konothrips tuttlei* (zur Strassen)

*Chirothrips tuttlei* zur Strassen 1967b: 345.

*Konothrips tuttlei* [*sic*]: Bhatti 1990: 196.

**Distribution:** Mexico, United States (AZ).

## Key to species of *Konothrips*

1. Invaginations of mesosternal furcal arms widely separated by about width of mesothoracic coxae; abdominal submarginal sculpture oriented longitudinally (Fig 42); ovipositor without teeth ..... *tuttlei* (zur Strassen)
- . Invaginations of mesosternal furca separated by 3/10 to 2/5 width of mesothoracic coxae; abdominal submarginal sculpture oriented diagonally (Fig. 50); ovipositor with sparse teeth. .... *colei* sp.n.

## *Oelschlaegera* Bhatti

*Oelschlaegera* Bhatti 1990: 198. Type species: *Chirothrips madagassus* zur Strassen by original designation.

**Female:** Macropterous. Antennal segment I not enlarged, less than 2.5 times as wide as base of segment II; segment II produced laterally, lateral process with a rather pronounced apex, subapical seta on lateral margin; anterior margin straight. Head strongly produced anterior of compound eyes, lateral margin of vertex at least 50 µm long, about as long as compound eye; 14 plus pairs of short conical setae on vertex. Pronotum subtrapezoidal, with shorter, conical setae than on head. Fore femur with pair of stout distal setae. Prospinal sternum well developed band. Mesonotum with 2 pairs of conical setae positioned medially, near or on posterior margin; mesosternal furca invaginations not separated. Metanotum with median pair of conical setae. Fore wings with well developed costal setae. Abdominal tergites and sternites with transversely oriented sculpturing, with broad transverse posteromarginal flange; anterior tergites with conical setae; sternites with 3 pairs of setae on II–VII, sternites II–IV with conical or less stout setae; ovipositors well developed, with teeth.

**Males:** Unknown.

**Comments:** This genus differs from *Chirothrips* females by having many conical setae on the head, and several conical setae on the mesonotum, metanotum and anterior abdominal tergites and sternites; fore femur has a pair of stout, spine-like distal setae; and abdominal sternites have broad posteromarginal flange. In *Chirothrips* 2–6 pairs of bristle-like or short, stout setae are on the head, mesonotum and metanotum; abdominal tergites have bristle-like or nearly spine-like setae; fore femur lack stout, spine-like distal setae; and abdominal sternites either lack posteromarginal flange or the flange may be present as lobes, teeth, or elongated plates. The concept of *Oelschlaegera* is here revised.

## ***Oelschlaegera priesneri* (Hood) comb.n.**

*Chirothrips priesneri* Hood 1949a: 146.

**Distribution:** Brazil.

**Comments:** Mound and Marullo (1996) stated that this species resembled *C. ruthae* Hood (1949b) and belonged in a new genus. According to zur Strassen (1961), *ruthae* was similar to his new species *C. madagassus*, which Bhatti (1990) designated as the type species of *Oelschlaegera*. *Chirothrips ruthae* is assigned here to *Oelschlaegera* (New Combination) based on the examination of the holotype. The females of *O. priesneri* have similar antenna, head, conical setae, fore wing and broad tergal and sternal posteromarginal flanges as the description and illustration of *O. madagassus* and holotype of *O. ruthae*. *Oelschlaegera priesneri* females have glandular areas on abdominal sternites III–VI which are absent from the other two species.

## ***Unilobothrips* gen.n.**

Type species: *Unilobothrips cornuatus* sp.n.

**Female.** Macropterous. Antennal segment I not enlarged, segment II asymmetrical, segments III and IV each with forked sense cones. Head with truncate, interantennal process with short subapical tooth on each side, longer than and as wide as antennal segment I (Fig. 53); lateral margin of vertex anterior of compound eyes rather straight then broadly curved above antennal socket, spine-like setae anterior of fore ocellus; venter of head with cluster of longer spine-like setae between compound eyes (Fig. 54) Pronotum subtrapezoidal, with 2 pairs of posteromarginal setae; discal setae few; basantra membranous, without setae; prospinasternum a transverse band with conical spina. Mesonotum with bristle-like setae, submedian setae far anterior of posterior margin, posterior setae far anterior of posterior margin and slightly behind submedian setae; mesosternal furcal invaginations fused. Metanotum with 2 pairs of bristle-like setae. Fore wing with costal setae. Abdominal tergites with few setae; posteromarginal flange short, as conical teeth submarginally, medially as low lobes (Fig. 59); sternites with posteromarginal setae; ovipositor well developed, about 170 µm.

**Male.** Brachypterous. Head with conical, interantennal process shorter than antennal segment I (Fig. 58); abdominal sternite with glandular area.

**Etymology.** Composed from Latin “uni” (one), “lobus” (lobe) and “thrips” (common name of Thysanoptera). The female of this monotypic genus has an elongate, truncate interantennal process.

**Comments.** The females have an elongate interantennal process with truncate apex which is not found in the other chirothripine genera. Moreover, a cluster of small, spine-like setae on the venter of the head of females of this genus is found only in some members of the *Arorathrips*.

## ***Unilobothrips cornuatus* sp. n.**

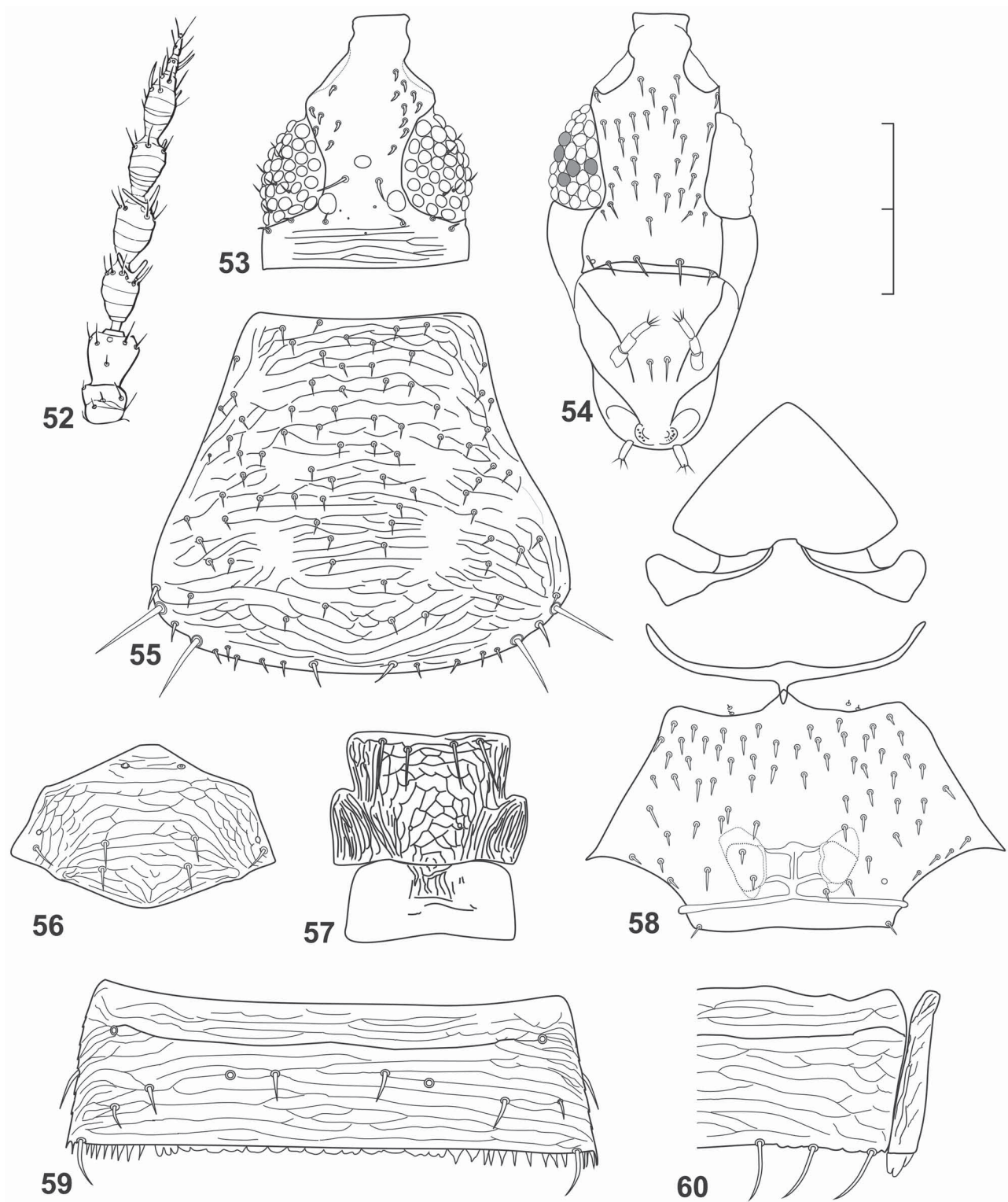
(Figs 52–67)

**Female.** Macropterous. Body brown; legs brown except all tarsi yellow, fore tibiae yellowish brown distally; ocellar crescent not seen; body setae pale brownish yellow; fore wings light yellowish brown; antennae brown except apex of segment II yellow, III with pedicel yellow and rest of segment yellowish brown.

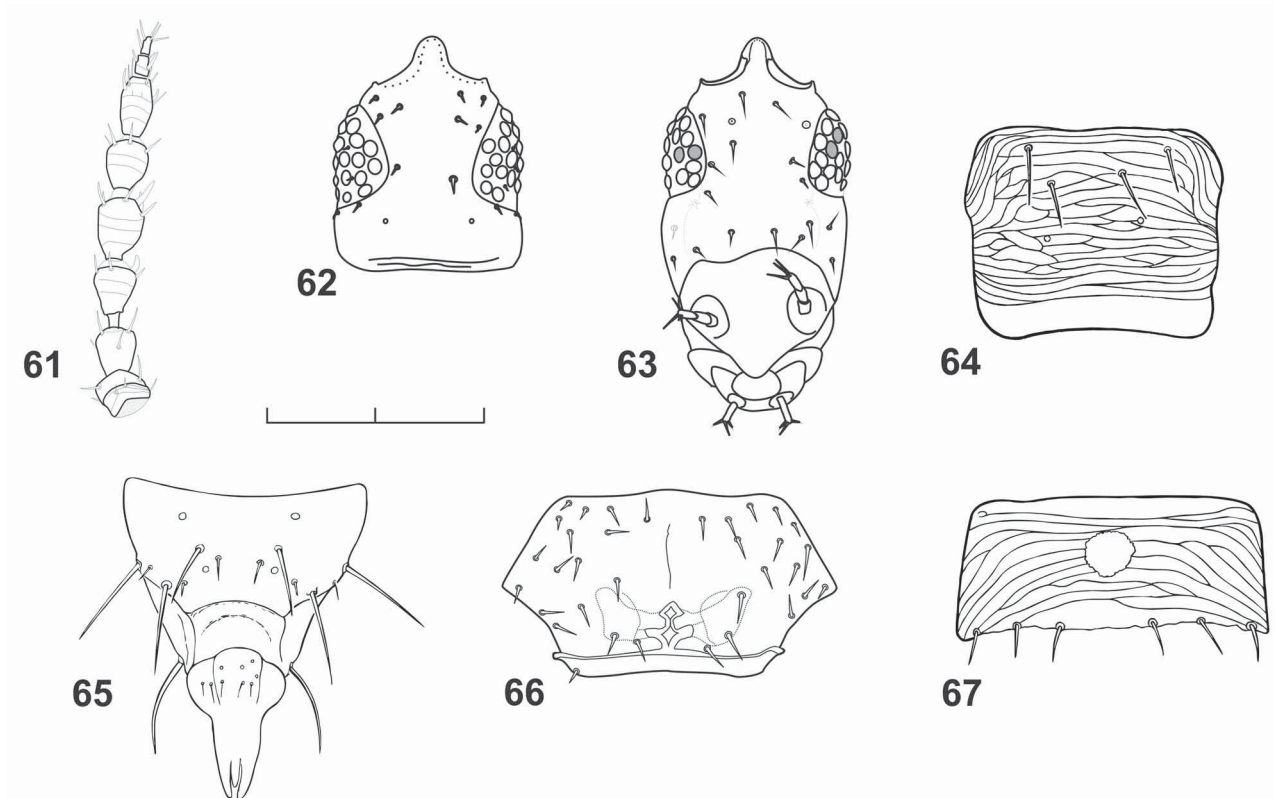
**Antenna** (Fig. 52): Segment I smaller than segment II, with dorsal transverse ridge; segment II slightly asymmetrical; segments III–V about as long as wide; segment VIII longer than VII; forked sense cones on segments III and IV, segment VI with inner sense cone in anterior 1/2, extending to segment VII.

**Head** (Figs. 53, 54): Prolonged anterior of eyes; interantennal process broad, truncate at apex, with rounded tubercle or broad tooth-like process on each side, wider than segment I, extending to about midlength of segment II; lateral margin of vertex anterior of compound shorter than length of occiput; compound eyes about twice as long as occiput; transverse striae on occiput, absent between and anterior of compound eyes; 17 (16) short, spine-like setae cephalad of fore ocellus, ocellar setae between anterior and posterior ocelli, postocular seta minute, 1 just caudad of posterior ocelli, 2 just caudad of compound eyes; 22 (20) ventral setae in addition of normal setae, slightly longer than those on dorsum; mouthcone with broadly rounded apex.





**FIGURES 52–60.** *Unilobothrips cornuatus* **sp. n.**, holotype female. (52) right antenna, dorsal aspect; (53) head, dorsal aspect; (54) head ventral aspect; (55) pronotum; (56) mesonotum; (57) metanotum; (58) pro- and mesosterna; (59) abdominal tergite IV; (60) abdominal segment VI, sternites and pleurites. Scale bar 100µm.



**FIGURES 61–67.** *Unilobothrips cornuatus* sp. n., male paratype. (61) right antenna, dorsal aspect; (62) head, dorsal aspect; (63) head, ventral aspect; (64) metanotum; (65) abdominal tergites IX and X; (66) mesosternum; (67) abdominal sternite III. Scale bar 100µm.

**Pronotum** (Fig. 55): Posterior part wider than anterior part, wider than long, completely sculptured with anastomosing lines; about 79, short, rather stout discal setae, 5–10 µm long, in broad median and submarginal bands; 2 pairs of well developed posteroangular setae, 11 posteromarginal setae, median pair slightly longer than others. **Prosternum** (Fig. 58) with basantra finely granulose, lacking setae; ferna well developed, divided; propinasternum strap-like, with produced spina. **Mesonotum** (Fig. 56): sculptured with transverse lines and reticulations, striae lacking minute teeth; 2 anteromedial campaniform sensilla present; median setae far anterior of posterior margin, posterior setae far anterior of margin slightly behind median setae; 65 sternal setae present. Mesonotum without spinula (Fig. 58). **Metanotum** (Fig. 57): reticulated, median setae slightly caudal of anterior margin, about as long as lateral setae; 2 campaniform sensilla in posterior 1/3 of notum; 28 sternal setae present. **Fore legs**: Well developed, apical margin of femora not reflected, apex of tibiae truncate.

**Fore wings**: Rather straight, tapering to a blunt apex; 22 (19) costal setae, those at midlength about as long as width of wing; 24 (20) slightly wavy anterior fringe cilia; fore vein with 6 (4) setae in proximal 1/2, 2 setae in distal 1/2; hindvein with 5 (5) setae; scale with 5 marginal and 1 discal setae.

**Abdomen**: Tergites (Fig. 59) transversely sculptured; median setae on tergite I minute, median setae on anterior 1/2 on tergites II–VIII, slightly anterior of median campaniform sensilla, slightly shorter to about as long as D2 setae; posteromarginal flange as lobes medially, submarginally and laterally with teeth; tergite IX shorter than XI with 2 pairs of campaniform sensilla, B1 setae slightly longer than tergite X; tergite X almost or completely divided by dorsal split. **Pleurotergites** (Fig. 60) with posteromarginal teeth. **Sternites** (Fig. 60) transversely sculptured; sternite I with anteromedial setae; sternite II with 2 pairs of posteromarginal setae, sternites III–VII with 3 pairs, median pair on VII slightly cephalad of posterior margin margin, closer to B2 setae than to each other; low posteromarginal lobes on sternites II–VI, more distinct on anterior sternites; ovipositor about 185 µm long.

**Measurements of holotype female (and female paratype)**: Body length 1.37 mm, 1.91 mm distended. Other measurements in µm. Antenna: total length 220 (213); length and width of antennal segment I 24 (27), 24 (24); II 30 (31), 30 (28); III 35 (32), IV 33 (35), 37 (32); V 32 (32), 30 (32); VI 37 (37), 35 (37); VII 10 (8), 10 (7); VIII 15

(12), 5 (5). Head: length from interantennal process 151 (141); lateral margin cephalad of compound eye 12 long; compound eye 62 (67) long; occiput 24 (24) long. Pronotum 215 (200) long, 254 (235) wide. Fore wings 902 (783) long, 54 (50) wide at midlength. Abdominal segment IX 64 (62) long, X 91 (86) long. Setal lengths: pronotal discal setae 7–10 long, posteroangular setae outer pair 40–50 (42), inner pair 42–47 (35–37), posteromarginal median pair about 10 long; metanotal median setae 27 long, lateral setae 37 long; abdominal tergite IX with B1 setae 100 (84) long, B2 setae 104 (89) long, tergite X with B1 setae 86 (84) long.

**Male.** Brachypterous. Similar to female in coloration.

**Antenna** (Fig. 61): Segment II asymmetrical, segment III apparently with simple sense cone, segment IV with main sense cone simple, a well developed simple sense cone on outer margin.

**Head** (Fig. 62, 63): Longer than wide, prolonged anterior of eyes; interantennal process conical, ventrally with tooth on each side near apex, apex resembling a "rounded, sclerotized cap", narrower and shorter than than antennal segment I; antennal base reduced, lateral part resembles a tooth; compound eye with 2 pigmented ommatidial facets; ocelli absent; 7 setae on vertex; ocellar setae posterior of and separated from setae on vertex; 2 short, postocular setae on each side just caudad of eyes; venter with normal, bristle-like setae in contrast to female.

**Pronotum:** Transversely sculptured; 32 discal setae in 2 submedial rows and on submargins, 2 developed posteroangular setae, 8 posteromarginal setae. **Mesonotum:** Similar to that of female. **Metanotum** (Fig. 64): Subrectangular with transversely oriented sculpturing; median and lateral setae posterior of anterior margin; 2 campaniform sensilla in about midlength as widely separated as median setae.

**Fore wing:** Brachypterous.

**Abdomen:** Tergite IX (Fig. 65) with B1 setae posteromedial of longer D1 setae, B2 setae closer to long, posterolateral setae than to B1 setae; campaniform sensilla between B1 and B2 setae, another pair anterior of D1 setae near anterior margin. Abdominal sternites III (Fig. 67) and IV each with circular glandular area, 27  $\mu\text{m}$  wide, 24  $\mu\text{m}$  long on III, slightly larger on IV.

**Measurements of male paratype.** Body length 1.38 mm distended. Other measurements in  $\mu\text{m}$ . Antenna: Total length 169; length and (width) of segment I 17 (24); II 24 (22); III 30 (21); IV 30 (22); V 24 (17); VI 37 (17); VII 7 (7); VIII 10 (5). Length of head from interantennal process 114, eye 50, occiput 31. Pronotum 148 long, 178 wide. Setal length: pronotal posteroangular setae outer pair 24, inner pair 35–37 long; on abdominal tergite IX D1 setae 37 long, B1 setae 12 long, B2 setae 10 long.

**Type material.** Holotype female (CAS), 1 female and 1 male paratype: Three Forks (on Madison River), Gallatin Co., Montana, sweeping, 23-VII-83, J. D. Pinto (UCR-83-125) (CAS).

**Distribution.** United States (MT).

**Etymology.** Specific epithet from Latin "cornuatus", horn-like, in reference to the horn-like interantennal process of this species.

**Comments.** No other North American species has a long interantennal process.

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